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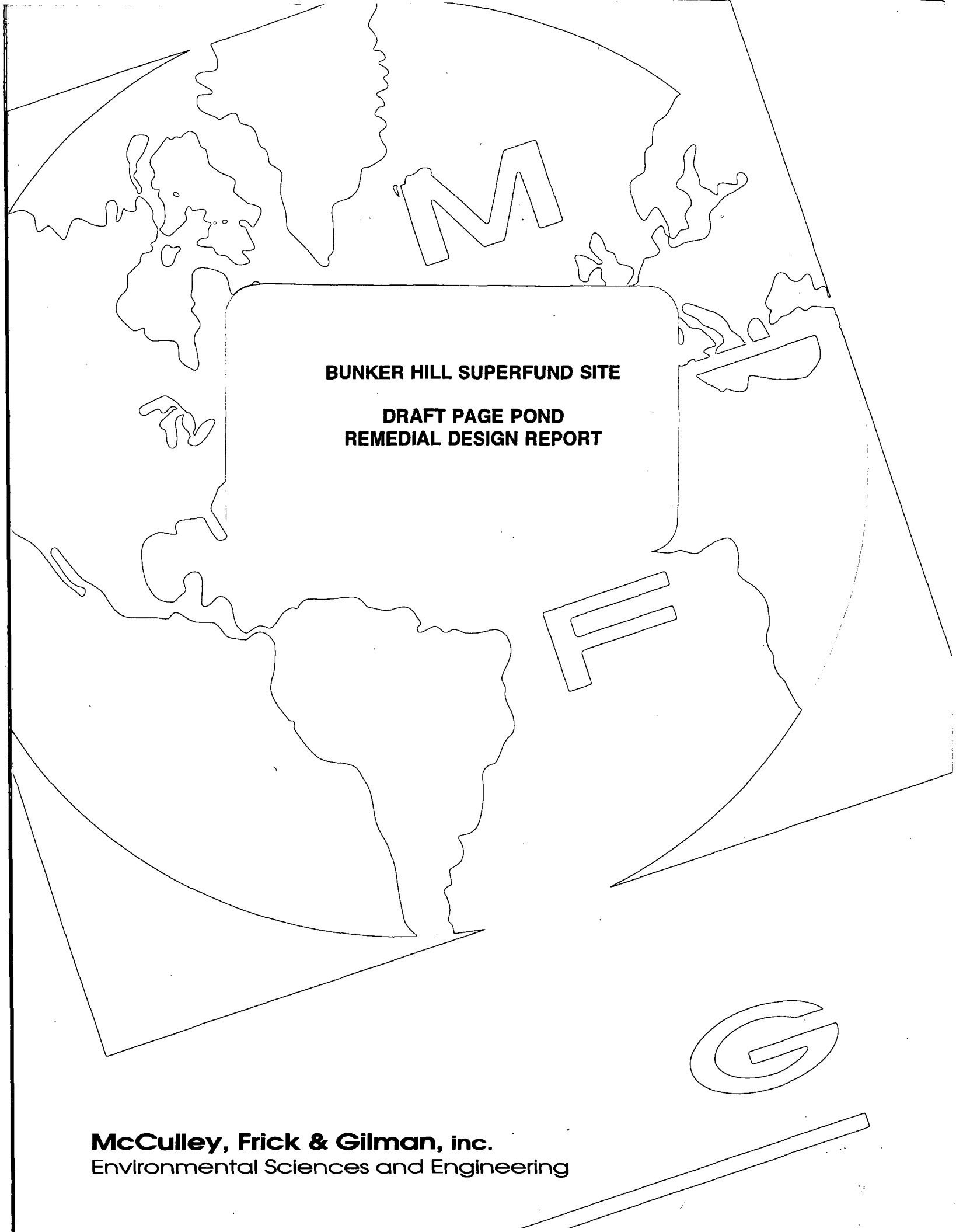

BUNKER HILL SUPERFUND SITE

DRAFT PAGE POND
REMEDIAL DESIGN REPORT

McCulley, Frick & Gilman, inc.
Environmental Sciences and Engineering

BUNKER HILL SUPERFUND SITE

DRAFT PAGE POND
REMEDIAL DESIGN REPORT

March 1994

Prepared For:

ASARCO INCORPORATED, HECLA MINING COMPANY, SUNSHINE MINING COMPANY

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1.0 INTRODUCTION

This Remedial Design Report (RDR) establishes the post-remediation configuration of the Page Pond area and the work necessary to produce such a configuration, as included under the remedial alternative for the Site described in the September 1992 Record of Decision (ROD). Upon completion of remedial actions, the Page Pond area is to remain available for continuation of existing uses, including operation of the existing wastewater treatment plant, and ongoing disposal of contaminated soils resulting from residential yards remediation. The existing wetlands (swamps) bordering Page Pond are also to be maintained, to the extent practicable. This RDR describes the designs for closure of Page Pond along with activities to enhance and maintain the swamps.

1.1 BACKGROUND

Page Pond is the repository for flotation tailings produced by the Page Mill in Humboldt Gulch. The mill began producing tailings in 1926 and continued operations until 1968. The tailings were transported as a slurry, in a flume or pipeline, to the valley of the South Fork of the Coeur d'Alene River (SFCDR). In 1974 the SFCDR Sewer District constructed the Page Pond Wastewater Treatment Plant (PPWTP) on top of the inactive tailings impoundment. The PPWTP consists of four aeration lagoons and a stabilization pond, covering a total of approximately 30 acres near the center of the 70-acre flotation tailings impoundment (D&M, 1990). The PPWTP also includes access roads and a process building, located on the north side of the impoundment.

Two natural wetlands, the East and West Swamps, are located to the east and west, respectively, of Page Pond. The water levels and surface areas of these swamps fluctuate seasonally, being

greatest during rainfall and snowmelt in the spring and early summer, and decreasing in the late summer/fall dry season.

The West Swamp contains several accumulations of exposed tailings. The greatest of these accumulations is in an area at the west end of the swamp known as West Beach. There are also lesser accumulations in other localized areas of West Swamp, including a fan of tailings at a decant discharge near the west edge of the Page Pond impoundment, another fan at a decant discharge near the northeast corner of the impoundment and miscellaneous smaller accumulations along the North Channel between the impoundment and the railroad embankment. There is little direct evidence to verify the existence of large quantities of tailings in the East Swamp, as noted in the Page Pond Swamp Soil Sampling Results (Appendix A).

1.2 PERFORMANCE OBJECTIVES AND STANDARDS

The remedial actions associated with Page Pond and the adjacent swamps are intended to mitigate the potential for contamination of surface and ground water; provide a barrier against direct contact with tailings; and reduce the potential for wind-blown dust. They are also intended to decrease leachate generation from Page Pond deposits; provide an ongoing repository for contaminated soils; and maintain and enhance the wetland habitat of the area. As noted in the Consent Decree Statement of Work (SOW), the Page Pond Element of Work includes the Page Pond Component and the Humboldt and Grouse Creeks Component. Specific objectives and the Performance Standards for these Components of Work are presented below.

1.2.1 Page Pond Component

The objective of this Component of Work is to limit releases from this location by consolidating, capping and revegetating. These objectives will be accomplished through attainment of the following Performance Standards:

- Portions of the exposed tailings located in shallow areas such as the West Beach of the West Page Swamp area and the areas surrounding the decant lines will be removed, to the extent technically feasible, and subsequently placed on the Page Pond benches for use as a sub-base for a vegetated cover. To the extent that tailings in these and other shallow areas cannot be removed, the areas will be covered with a minimum of 12 inches of clean soil and revegetated. All other areas will be submerged under approximately 2 feet of water. To the maximum extent practicable, these water levels will be maintained throughout the year. The amount of material to be removed from shallow areas such as the West Beach of the West Page Swamp and the areas surrounding the decant lines will be determined during remedial design and will consider the feasibility of effectively removing and relocating tailings deposits, including tailings moisture content and texture, current vegetated status, surficial soil contaminant concentrations, water levels, and habitat. The design will be subject to EPA approval.

- Page Pond benches will be covered with a minimum of six inches of contaminated soils, regraded to promote runoff, and revegetated.

- Page Pond impoundment dikes will be regraded to provide slope stability and then revegetated after placement of a minimum of six inches of clean soil. Contaminated soil may be used provided that access is adequately controlled, as determined by EPA.

- Adequate controls will be provided to prevent public access to the remedial actions performed at Page Pond.

- Wetlands associated with the Page Pond areas will be monitored for sediment and water quality. Water quality sampling will occur twice annually at two inflow and two outflow points for the year prior to and the five years following remediation. Sediment sampling will be consistent with the 1993 transect sampling program and will occur immediately after remediation and again at five years after remediation. Water and sediment sampling requirements are presented in Section 6.0 of this RDR.

- Biomonitoring will be conducted at the Page Pond Swamps in the year prior to remediation and for the next five years after remediation. The monitoring will consist of bird surveys and mammal tissue sampling. Biomonitoring requirements, including provisions for long-term monitoring, are presented in Section 6.0 of this RDR.

1.2.2 Humboldt and Grouse Creeks Component

The objective of this Component of Work is to limit the contamination of these surface streams by preventing contact with the Page Pond area tailings. Only those portions of Humboldt and Grouse Creeks within the Area I boundaries, as delineated by the Allocation Map, are addressed by this component. This objective will be accomplished through attainment of the following Performance Standards:

- Humboldt and Grouse Creeks will be isolated, to the degree practicable, from contact with tailings accumulations by the use of diversions and stream channel modifications in the existing channels north and south of the Page Pond Impoundment. Outlet control weirs will be constructed to maintain consistent water levels in the East and West Page Swamps to the degree practicable.
- Final configuration of any channel modifications will take into account habitat considerations. The design will be subject to EPA approval.

Channel improvements associated with this Component of Work will be designed to accommodate estimated flows from the 100-year, 24-hour storm event.

2.0 TECHNICAL ANALYSIS

This section addresses the technical investigations that were conducted prior to and in preparation for the development of designs and specifications for the closure of Page Pond and remediation of the adjacent areas. Specifically, this section provides assessments of hydrologic, hydraulic and geotechnical site characteristics, as well as physical surveys and sampling activities relevant to the remedial design, including:

- the hydrology of Grouse and Humboldt Creeks, feeding into the swamps;
- the hydrology and hydraulics of the swamps and the connecting channels;
- a geotechnical evaluation of the existing embankment slopes;
- a preliminary analysis of potential settlement of the existing tailings under the superimposed loads of additional tailings and/or soils from residential yard remediations;
- a summary of Hydrologic Evaluation of Landfill Performance (HELP) Model analyses previously performed;
- a physical survey of the extent of tailings located in the West Beach area of West Swamp; and
- sampling and analysis of sediments collected from West Swamp.

The technical analyses include recommendations regarding application of appropriate technologies and materials for site-specific remediation. These recommendations are incorporated into the discussion of preliminary designs in Section 3.0. The spatial relationship of the major components of the Page Pond area are shown on Figures 2-1 and 2-2.

2.1 REMEDY OVERVIEW

The selected remedy for Page Pond will include source removal, channel improvements and other protective works to meet the objectives and standards set out in Section 1.2. To the extent technically feasible, exposed jig tailings will be excavated and relocated to the Page Pond impoundment area for disposal and protection beneath a soil cover. The majority of these tailings will be removed from the West Beach area, but lesser volumes will also be excavated from the fan emanating from the decant discharge at the northeast corner of Page Pond and from localized deposits along the length of the North Channel. The removed jig tailings will be placed on the West Beach of Page Pond and graded to promote positive drainage.

The East and West Beach areas will be established and operated as repositories for contaminated soils excavated during remediation activities and subsequent construction activities in the nearby communities. "Contaminated soils", as defined in the SOW, includes those contaminated soils which are removed during remediation of Area I for disposal at the Page Pond Repository or other EPA-approved disposal site. Contaminated soils that have been removed during the remediation programs that have been conducted from 1989 to 1993 have been disposed of on both the East Bench and West Bench, with the majority of the material going to the East Bench. Soils from future remediation work will be deposited first on the East Bench, to cover the remaining exposed tailings there and fully utilize the remaining disposal capacity of that area. Thereafter, disposal will occur at the West Bench area.

Current estimates of expected soils generation from future remediation activities, compared with estimates of remaining disposal capacity, indicate that there may be insufficient capacity to dispose of all of these soils on the existing West Bench. This analysis is presented in greater detail in Section 2.5 of this RDR. In order to assure adequate disposal capacity, the West Bench will be extended westward approximately 200 feet. Initially, soil

placement activities will focus on raising the soil surface to an elevation similar to that of the existing West Bench. Thereafter, and if additional disposal volume is required, contaminated soil will be distributed on the surface of the existing West Bench and its extension to an elevation similar to that of the existing PPWTP dikes. The expansion of the West Bench will also provide a protective cover for the existing exposed tailings which form a fan at the decant discharge adjacent to the current west embankment of West Bench. No expansion of the East Bench is contemplated. Long-term operation of this repository, subsequent to the completion of the residential areas remediation program, will be considered as part of the permanent Institutional Controls Program (ICP). Additional soils from Area I and outside Area I may also be accepted at Page Pond, if capacity allows.

The existing north, east and south perimeter embankments of Page Pond will be regraded, as necessary, to ensure stability, and will be covered with a minimum 6-inch layer of contaminated soils and revegetated. Access to the Page Pond area will be controlled with fencing and gates, as appropriate.

The channels conveying Humboldt and Grouse Creek flows adjacent to Page Pond will be upgraded, as necessary, to safely accommodate the design flood flows (i.e., those resulting from a 100-year, 24-hour flood event). Outlet control weirs will be constructed at the discharge points from the East and West Swamps to establish and maintain minimum water levels in the swamps, and thereby limit the potential for cyclic wetting and drying of remaining tailings. Discharge of effluent from the PPWTP may also be directed into the West Swamp, which would further assist in reducing seasonal fluctuations. Any further studies related to this option will be the responsibility of the sewer district. The impoundments formed upstream of the weirs are expected to attenuate flood flows from the source creeks and the impounded water should enhance wetland habitat. The specific extent of applicable remedial actions will reflect the overall objective of preserving and enhancing the existing wetlands habitats.

2.1.1 Compliance With State and Federal ARARs

The remedial design presented in this RDR has been developed to provide for attainment of Performance Standards and, correspondingly, to comply with pertinent aspects of State and Federal ARARs. This compliance follows from the analyses of key State and Federal ARARs previously developed in the Bunker Hill FS Report, Appendix J (MFG, 1992).

The designs for Page Pond and for enhancement of the adjacent wetlands areas have been developed in consultation with State and Federal agency personnel, and are responsive to their requirements. The Page Pond impoundment closure design is in accordance with the requirements of the State of Idaho Rules and Regulations for Mine Tailings Impoundment Structures as well as pertinent aspects of RCRA requirements governing Disposal of Solid Waste (placement, cover and control of access to disposed solid wastes) and those governing Landfill Closure (cover materials characteristics and placement, runon/runoff control). Tailings removal and fill placement operations will be in accordance with the requirements of the Clean Water Act, the Protection of Wetlands Executive Order 11990 and the Protection of Floodplains Executive Order 11988, and the construction of flow control structures and channel protection works in the Page Swamps will be in accordance with the Clean Water Act. Conceptual design of wetlands enhancement works and development of the biomonitoring plan has been developed through consultation with EPA, IDHW and the U.S. Fish & Wildlife Service and incorporates their requirements.

2.2 HYDROLOGY OF GROUSE AND HUMBOLDT CREEKS AND PAGE SWAMPS

Grouse Creek is a perennial stream that drains an area of approximately 0.56 square miles (360 acres). The catchment area includes a portion of Smelterville as well as the hillsides south of the community and the East Swamp. Humboldt Creek, also a perennial stream, drains an area of approximately 1.6 square miles (1,000 acres) west of the Grouse Creek drainage and discharges into

the West Swamp. The length of the longest water course in the Grouse Creek drainage is approximately 2 miles, while the longest water course in the Humboldt Creek drainage is approximately 2.2 miles. The average basin gradients for Grouse and Humboldt Creeks are approximately 19 percent and 21 percent, respectively.

The drainage basin hydrologies were assessed using the HEC-1 computer model in conjunction with the Soil Conservation Service (SCS) Unit Hydrograph method. SCS curve number selection for the basins was based on the SCS Soil Survey for the Silver Valley Area (USDA, 1972) and RI (MFG, 1992) data regarding vegetation cover in the area. The hydraulics of the Page Swamps were also assessed using the HEC-1 computer model, with reservoir topography derived from air-photo contour mapping (1" = 100 ft, with 2-foot contours). The model output provided flood stage and discharge data for storm flows routed through the swamp reservoirs.

Typically, spring and early summer flows into the East and West Swamps exceed evapotranspiration losses, and surplus water discharges from the swamps and ultimately to Pine Creek. In the East Swamp, the current outlet elevation is at approximately 2,203 feet above mean sea level (AMSL), while in the West Swamp the outlet elevation is approximately 2,188 feet AMSL. In the later summer and early fall, evapotranspiration losses typically exceed inflows, outflows cease, swamp water levels fall and the areas of impounded waters within the swamps diminish.

Flow from Grouse Creek discharges into the East Swamp, passes through the swamp area and discharges, at the northwest corner of the swamp, to a connecting channel (the "north channel") flowing westward along the north edge of the Page Pond impoundment to the West Swamp. The peak discharge from the East Swamp to the connecting channel, as a result of the 100-year, 24-hour storm event, is estimated to be approximately 127 cubic feet per second (cfs).

Flow from Humboldt Creek currently passes through a culvert beneath the existing road south of Page Pond, and discharges into a channel flowing westward between the road and the south embankment of Page Pond. The peak flow from Humboldt Creek and other local drainages on the south side of Page Pond, resulting from the 100-year, 24-hour storm event, is estimated to be approximately 364 cfs. Rip rap protection will be required along a portion of the south embankment, in the area where the impinging flow from the road culvert is redirected westward, to avoid excessive erosion along this reach during flood flows.

The discharges from Humboldt and Grouse Creeks merge in the West Swamp, where significant attenuation of storm event peak flows is expected to occur. The estimated discharge rate of the combined 100-year, 24-hour storm flow from the West Swamp, following attenuation, is approximately 230 cfs. This attenuation and slower discharge is reflective of the relatively large surface area and storage volume of the West Swamp and the resulting reduced hydraulic gradient. This calculated discharge rate was used as the basis for design of the West Swamp outlet control weir, and downstream channel and culvert works to the discharge point at Pine Creek. Potential inclusion of PPWTP effluent flows should not affect the design of these works. PPWTP flows range from 2.39 to 4.43 cfs and are not affected by runoff conditions.

2.3 SWAMP LEVEL FLUCTUATIONS AND CYCLIC TAILINGS EXPOSURE

In late summer and fall, water levels in the East and West Swamps fall and the wetted areas of the swamps decrease as inflows from tributary creeks decrease. Surface water measurements were taken at the East and West Swamps during Page Pond investigations, in December 1987 through September 1988 (D&M, 1990). These measurements indicate that the wetted area of the East Swamp varied from approximately 1 acre during the low flow period to approximately 12 acres during the high flow period. The wetted area of the West Swamp varied from approximately 0.34 acre during

the low flow period to approximately 27 acres during the high flow period.

In the West Swamp, the annual water-level fluctuation results in cyclic exposure and drying out of areas of deposited tailings in the summer and fall, followed by resaturation in the spring. Under these conditions, metals in sulfide minerals in the tailings tend to oxidize in the summer months, with oxide crusts forming on the sulfide and other particles. These metal oxides dissolve when wetted in the spring and during periodic rainstorms, and are transported downstream. Oxidation again occurs when the tailings dry out in the next cycle. This repeated process results in pulses of metals being delivered to area ground water and surface water during the spring and after each late-season rainstorm. The effects of this metals pulsing have been observed in Smelterville Flats (Williams and Swanson, 1990). To overcome this situation, the conceptual plan calls for maintenance of a submerged condition in the West Swamp, to prevent the wetting and drying cycles and the resultant seasonal metals discharge.

Because there are few, if any, tailings in the East Swamp, the annual fluctuation of water levels and resultant drying and resaturation of materials in this area is not thought to be a significant source of dissolved minerals to ground water. Nonetheless, actions are contemplated to maintain minimum water levels in the East Swamp also, which may serve to enhance the wetlands habitat in the area.

2.4 ASSESSMENT OF EXISTING PAGE POND IMPOUNDMENT AND EMBANKMENTS

The Page Pond impoundment covers an area of approximately 70 acres, and the perimeter of the enclosing embankment is approximately 1.4 miles. The maximum east-west dimension of the impoundment is approximately 2,800 feet, and the maximum north-south dimension is approximately 1,300 feet. The original impoundment area was divided by a north-south dike, which now lies beneath the PPWTP. Existing tailings depths vary from

approximately 20 feet to a maximum of approximately 30 feet. Deposits in Page Pond consist primarily of flotation tailings, similar to those found in the CIA (Pfahl, 1992). The external embankments surrounding the tailings impoundment are comprised primarily of mine waste rock overlying floatation tailings. They vary in height from approximately 18 to 24 feet and have slopes varying from approximately 1.2(h):1(v) to 2:1. Smaller embankments, constructed on top of the tailings to form the PPWTP impoundments, vary in height from approximately 6 feet at the eastern side of the stabilization pond to approximately 15 feet at the western side of the aeration ponds. Side slopes of these smaller PPWTP embankments vary from approximately 2.5:1 to 3:1. It is understood that the treatment pond embankments include a filter blanket along the toe, to permit free drainage of seepage through the embankments and enhance their stability, and that the treatment ponds are unlined. These factors together contribute to seepage through the tailings (Hitt, 1974). With the exception of some localized areas of erosion and minor sloughing, however, no significant deterioration of the embankments has been noted. Placement of contaminated soils against the PPWTP dikes is expected to enhance their stability. The buttressing effect of these soils should eliminate any concerns with respect to seepage along the dike toes, as transmitted by the previously installed filter blankets.

The surface of the existing deposited tailings, west of the PPWTP impoundments, currently slopes at approximately 0.4 percent to a low point near the center of the west embankment, where an old decant is located. The surface of the existing tailings, east of the PPWTP impoundments, currently slopes toward the northeast corner of the impoundment, where a similar decant exists. It will be necessary to remove these decants prior to placement of additional tailings or residential yard soils on the tailings in the vicinity of the decants.

Areas of seepage are evident along both the north and south tailings embankments. These seeps appeared following construction

of the PPWTP. It will be necessary to accommodate continued drainage of these seeps to the swamp areas, in a manner that limits erosion of the regraded, vegetated slopes.

The State of Idaho Rules and Regulations for Mine Tailings Impoundment Structures (1980) require that the slope of downstream (outside) faces of embankments be 2:1 or flatter, in the absence of stability analyses. Closures for other small tailings impoundments in the Silver Valley area have been constructed with 2:1 slopes, and these have provided adequate stability and have supported successful revegetation efforts. The existing Page Pond embankment slopes do not show signs of instability in their current configuration, however, they will be regraded and flattened, to a slope of 2:1 or flatter, to enhance their long-term stability and conform to regulatory requirements.

As discussed earlier and in the following section, Page Pond will serve as a repository for the disposal of contaminated soils excavated from residential areas during future remediation activities. Therefore, the closure design must provide adequate volume for such disposal over the long-term. Comparison of the anticipated volume of contaminated soils requiring disposal versus an assessment of the available storage capacity on the existing Page Pond benches indicates that the existing bench areas may be insufficient to satisfy the long-term need. To accommodate the anticipated surplus volume of contaminated soils, the West Bench disposal area will be extended westward by approximately 200 feet (toe distance). This extension, as discussed in greater detail in Section 3.3, is expected to provide an additional disposal capacity of approximately 100,000 cy, relative to the volume that would otherwise be available on the West Bench. Finished slopes of this extension will be graded to a conservative slope of 3:1 or flatter to allow for potentially low strength characteristics of the contaminated soil. This extended fill will also effectively cap and eliminate the need for removal of presently exposed tailings in the fan adjacent to the toe of the west Page Pond embankment. The present surface elevation of the West Fan area is approximately

2293 feet AMSL. This area is not known to have been inundated by fluctuating water levels in the West Swamp. Also, the weir crest elevation for the West Swamp outlet is designed to be 2189 feet AMSL. Therefore, newly placed residential soils in the West Fan area are expected to remain dry, and potential stability problems associated with submerged conditions along the embankment toe are not expected.

2.5 CONTAMINATED SOILS STOCKPILES

The elevated bench areas of Page Pond, adjacent to the PPWTP, have been used as a disposal site for contaminated soils excavated during yard remediations in the populated areas of the Bunker Hill Superfund Site. These soils were removed from residential areas to limit the potential for human contact, especially by children, with lead-contaminated materials. Documentation of clean soil volumes imported to replace contaminated materials removed from residential yards show that approximately 90,350 cy of topsoil was purchased between 1989 and 1993 for yard remediation projects. Inspection of the disposed materials stockpiles show that approximately 65,000 to 80,000 cy of contaminated soils and those from the fast-track work have been placed on the Page Pond benches. Approximately 45,000 to 55,000 cy have been placed on the East Bench and a further 15,000 to 20,000 cy from the 1986 fast track activities, previously stored in an Idaho Department of Transportation (IDT) compound west of Page Pond, have now been relocated to the West Bench. It is further understood that approximately 5,000 cy of contaminated soils were stockpiled in Deadwood Gulch, outside of Area I. The apparent discrepancy between the volume of purchased materials and the aggregate volume of disposed materials is most likely due to the increased density of the compacted disposed contaminated soils compared to the loose material in the trucks supplying replacement materials. It is not unusual to experience a volume decrease in the order of 20 percent when loose soils are compacted.

As mandated by the SOW and described in the preceding section, the Page Pond benches are to serve as a repository for contaminated

soils that are excavated and require disposal during future remediation and construction activities in the local communities. It is expected that approximately 1,350 yards will be remediated and that, based on historical information, as much as approximately 200 cy of contaminated soils will be generated from each yard, yielding a total of approximately 270,000 cy. It is further estimated that remediation of Area I commercial properties and rights-of-way will generate a further 90,000 cy of disposal materials. After placement and compaction of these materials in the Page Pond repository, the effective disposal volume is estimated to be approximately 290,000 cy, assuming that compaction activities result in a 20 percent volume decrease. The designs presented in Section 3.3 are expected to provide adequate capacity to accommodate long-term disposal of these soils in the Page Pond area. Table 2-1 summarizes the estimated availability and utilization of disposal capacity on the Page Pond benches. Details supporting the estimates on Table 2-1 are provided in Appendix B. The contaminated soils, despite elevated concentrations of lead, are still relatively fertile and, therefore, are suitable as a growth medium for revegetation of unpopulated areas, provided that strict access controls are invoked.

2.6 PRELIMINARY SETTLEMENT ESTIMATES

As noted in Section 2.1, initial soil placement activities will focus on covering the West Fan and raising the soil surface to an elevation similar to that of the West Bench. Settlement of this newly constructed soil fill is expected to be small due to the relative thinness of tailings in the West Fan subgrade (approximately 2 to 3 feet) and because compaction activities will occur regularly as the soils are placed. The largest degree of settlement is expected on the West Bench of the existing tailings impoundment. As tailings, excavated from the West Beach area and the North Channel, and contaminated soils are placed on the West Bench, consolidation of the underlying flotation tailings will occur. The estimated depth of the existing flotation tailings in this area is approximately 20 to 22 feet. The maximum thicknesses

of the newly placed tailings and soil cover will be in the range of 12 to 15 feet, which may result in applied soil pressures of up to 1,800 psf. Consolidation test data do not exist for the tailings material at Page Pond, however, if it is assumed that the tailings materials in this area are similar to those found in the East Cell of the Central Impoundment Area (CIA), consolidation may be expected to be in the range of approximately 0.025 to 0.05 inches/inch at 1,800 psf. Based upon these data, and assuming that some pre-consolidation of the existing tailings has already occurred, as well as excluding possible minor additional settlement of the underlying subgrade, maximum future settlements are estimated to be in the range from approximately 5 to 12 inches. New materials placed over the existing tailings on the Page Pond benches will be compacted as they are placed, so future consolidation of these materials and further subsidence of the surface is not expected.

Any settlement occurring at Page Pond should be uniformly distributed, resulting in minimal disruption of the soil cover. Therefore, only periodic inspections of the closure surface will be necessary, and it will not be necessary to monitor pore pressures in the fill materials. A general survey of the closure surface will be conducted, after approximately one year of post-closure operation. If localized depressions are noted during the survey or inspections, these will be filled and regraded, as necessary, in order to maintain continued positive surface drainage.

2.7 SUMMARY OF HELP MODEL ANALYSIS AND RESULTS

A hydrologic analysis of the Page Pond closure system, based upon the HELP Model, was conducted during preparation of the RI/FS Technical Memorandum: Evaluation of Proposed CIA and Page Pond Closure Methods. The results of this analysis indicate that the proposed soil cover system will reduce infiltration of annual precipitation by approximately 50 percent, under average precipitation conditions, primarily through evapotranspiration and

some increased runoff. Results of this analysis are presented in Table 2-2.

2.8 EROSION POTENTIAL

Erosion potential at the Page Pond closure area was estimated based upon the Universal Soil Loss Equation (USLE). This is a semi-empirical equation, developed to allow prediction of erosion due to rainfall. The USLE was originally developed by the Agricultural Research Service (Wischmeier and Smith, 1965) to assist in prediction of erosion losses from cropland east of the Rocky Mountains. It has since been modified and adapted for other regions of the United States (USDA, 1972), as well as for use at urban and construction sites (Wischmeier et al., 1971, USEPA, 1973). The USLE takes into account all factors affecting rainfall erosion, including climate, soil type, vegetation, erosion control devices, and topography. The annual soil loss from a site is estimated according to the following equation:

$$A = RKSLCP$$

where:

A	=	the computed soil loss in tons (dry weight) per acre
R	=	the rainfall erosion index
K	=	the soil erodibility factor
LS	=	the slope length/gradient factor
C	=	cropping management (vegetation) factor
P	=	erosion control practice factor

The Soil Conservation Service (USDA, 1972) has established a relationship between Type II, 2-year frequency, 6-hour duration rainfall and the average annual rainfall erosion index. Based upon an anticipated 2-year, 6-hour rainfall at the site of 1.5 inches, the annual "R" factor is approximately 70. Assuming a silty cover soil, having approximately 90 percent silt, 6 to 7 percent sand and 3 to 4 percent organic matter, and with a moderate permeability, the soil erodibility factor (K) is estimated to be approximately

0.35. Slope length/gradient factor (LS) can vary from approximately 0.1, for a 100-foot long slope at 0.5 percent, to approximately 20, for a 2:1 slope on a 60-foot high embankment or cut slope. In this case an LS value of 0.27 is appropriate for the bench areas and a value of 12 is appropriate for the embankment slopes. Cropping management or vegetation factors (C) can vary from approximately 0.01 for a well established 90 percent grass cover to 1.3 for a newly placed soil graded with a bulldozer or scraper in a direction parallel to the fall line (Gray and Leiser, 1982). For the purposes of these analyses, it is assumed that a mulch such as a 1,000 lb/acre wood fiber slurry (C = .05) small grain straw mulch (C = .02) or an erosion blanket (C = .04) will be placed on regraded or capped surfaces prior to vegetation establishment. Therefore, a "C" value of 0.05 was assumed for the first year or two following construction at the area and a value of 0.01 assumed following vegetation establishment. The erosion control practice factor (P) can vary from 1.0 for no special treatment to a value of 0.25 for contouring or benching on a slope of 2 to 7 percent. Structural erosion control devices such as silt fences, hay-bale check dams, and the like can equate to a "P" value of 0.5 if used at a normal rate on a construction site, or 0.4 if used at a high rate (USEPA, 1973). In this case, a P value of 1.0 is appropriate for the bench areas and a value of 0.5 is appropriate for the embankment slopes.

Based upon the above-described assumptions, as much as 66 tons per year of sediment may be eroded from the 30 acre site (including tailings deposition areas and embankment side slopes) during construction and for approximately one year following closure. Assuming a dry unit weight of sediment of approximately 80 pounds per cubic foot (pcf), a sediment runoff volume of approximately 1,650 cf may result. Assuming vegetation is established on the closure and embankment slopes by the second or third year following closure, the estimated sediment erosion rate will be reduced to approximately 13 tons per year (=325 cf/yr). This value represents an erosion rate of approximately 0.43 tons of sediment per acre per

year, which is well below the maximum recommended allowable rate of 2 tons/acre/year (USEPA, 1985).

Temporary sediment control devices will be required on the Page Pond benches and near the West Swamp outlet, during construction, to trap sediments from runoff prior to discharge into adjacent existing waterways.

3.0 DESIGN

The remedial design for the Page Pond area is in accordance with the requirements presented in the ROD and subsequently in the SOW. Tailings in the West Swamp and North Channel, that would be exposed above the stable free water surface after completion of construction of the flow control weir at the West Swamp outlet, will be excavated, to the extent technically feasible, and hauled to the West Bench of Page Pond for final placement. To the extent that tailings in those other shallow areas cannot be removed or covered with approximately 2 feet of standing water, the areas shall be covered with a minimum of 12 inches of clean soil and revegetated. The channels will be upgraded, where necessary, to accommodate the peak design flows. The perimeter slopes of the Page Pond embankments will be regraded, as necessary, to improve stability and minimize erosion, and contaminated soils will be spread over the embankment slopes and bench areas of the impoundment and revegetated. Water level control weirs will be constructed at the outlets of the East and West Swamps, to maintain a continually submerged condition in as much of these wetlands areas as possible, even during dry months. To supplement the natural inflow to the swamps, consideration will be given to discharging treated effluent from the PPWTP to the West Swamp.

As stated in the SOW, this Draft Page Pond RDR provides the approved conceptual design for the Page Pond Element of Work. The Final Page Pond RDR will be based upon the approved conceptual designs presented in this Draft RDR.

3.1 EXCAVATION AND CAPPING OF SELECTED PAGE SWAMP TAILINGS

Selected areas of exposed tailings in the Page Swamp system will be excavated and disposed of on the Page Pond benches. The tailings in the West Beach area of the West Swamp comprise the majority of the tailings to be excavated. These tailings may have been reprocessed in past, but they exhibit physical and chemical characteristics similar to the tailings found in the balance of

Smelterville Flats. Other, smaller accumulations of exposed flotation tailings will also be excavated and disposed, if technically feasible. If exposed tailings remain in the areas of excavation, they will be covered with a minimum of 12 inches of clean soil. In the spring and early summer, swamp levels rise and the exposed tailings accumulations at West Beach and in the North Channel are temporarily flooded and saturated. The swamp sediments on which the tailings lie are perennially saturated. The remedial design contemplates removal of exposed tailings, however, in their saturated condition they are generally not trafficable by conventional equipment. Access is generally improved in the late summer and fall, when the water level in the West Swamp falls and the tailings dry out to some extent. To facilitate the excavation and removal process, it may be necessary to construct some temporary channels to further promote drainage from the swamp and expedite further drying of tailings.

The West Beach tailings cover an area of approximately 5 acres, with an average surface elevation of 2,190.5 feet AMSL (Swenseid, 1991). The preliminary remedial design concept provides for the West Swamp area to be permanently flooded to a maintained elevation after tailings removal. Metals in the remaining tailings, permanently submerged below the maintained water level, will not be subject to mobilization by periodic oxidation. Therefore, it will not be necessary to remove tailings to a depth greater than approximately 2 feet below the new permanent water level. The proposed crest elevation of the West Swamp outlet weir is 2,189 feet AMSL, and the water level after remediation should be maintained at this level year round. Therefore, those tailings above elevation 2,187 feet AMSL will be excavated and removed, to the extent technically feasible. It is estimated that this will require excavation of approximately 30,200 cubic yards of material (Swenseid, 1991). Technical feasibility of tailings removal is predominantly a function of the moisture content of the material. Tailings containing sufficient moisture to cause them to slough or flow, when excavated or placed with conventional earth moving equipment, will not be removed. However, tailings removal will

occur during the low water period to maximize the volume of tailings that can be removed.

The other significant accumulation of exposed tailings in the West Swamp is a fan, located immediately west of Page Pond. As discussed in Section 2.4, the upper region of this mostly barren fan is not submerged, even during high water. These exposed tailings will be effectively capped with contaminated soils as part of the expansion of the West Bench to provide additional disposal capacity in the Page Pond Repository. Therefore, these tailings will not be removed. Maintenance of a West Swamp water level at or below 2189 feet AMSL will ensure that the toe of the contaminated soil repository (elevation 2193 feet AMSL) does not become inundated. In West Bench areas where exposed tailings are not covered with residential soils, clean soils will be utilized as a cover.

Other areas of exposed tailings found in the West Swamp will be addressed, as necessary, to enhance stream channels and mitigate contaminant sources, in accordance with the criteria set out above. The total volume of tailings expected to be excavated from the lesser accumulations in the West Swamp has not been precisely estimated, however, it is not expected that the volume will be great enough to impact the closure design.

3.2 FLOW CONTROLS

3.2.1 East Swamp Outlet

As previously noted, there is little direct evidence to verify the existence of large quantities of tailings in the East Swamp. It is likely that metals present in the East Swamp soils are attributable to smelter emissions (see Appendix A). Since the East Swamp does not contain a significant quantity of tailings, cyclic seasonal saturation and drying of portions of this area should not result in significant problems with respect to metals mobilization. Thus, there is no particular need to stabilize the seasonal water

level fluctuations in this area. Excavation of exposed tailings from the North Channel and corresponding enlargement of the channel cross-section could increase the rate of drainage from the East Swamp, adversely affecting the existing habitat there. This will be prevented by constructing a weir across the eastern end of the North Channel to act as an outlet control. This weir will allow discharge of ponded water down to elevation 2,203.5 feet, but prevent discharge below that level. Because the water level in the East Swamp is directly and solely dependent upon inflow from the Grouse Creek drainage, the water level in the swamp may decline below the design level, due to evapotranspiration in dry weather, and the area of the East Swamp may shrink in the summer and early fall, as it does now. However, construction of the outlet control weir will raise the discharge elevation from the East Swamp by approximately two feet above the elevation of the existing channel mouth, and wetting of the swamp will be prolonged to a greater extent than if no outlet control weir were to be constructed.

3.2.2 West Swamp Outlet

To minimize water level fluctuations in the West Swamp, and to maintain unexcavated tailings in a submerged condition, as discussed in Section 2.2, an outlet control weir will be constructed at the point where the swamp discharges into the channel flowing to Pine Creek. As previously noted, the weir will be constructed with a discharge spillway at elevation 2,189 feet AMSL. If water supplies allow, the West Swamp water level will be maintained at this elevation year-round.

The outlet control weirs in each swamp will consist of compacted earth fill embankments, with reinforced concrete sills on the crests and armored spillways on the downstream faces. This design will permit free overflow of water, without erosion of the structure. Details of the outlet control weirs are shown on Figure 3-1. Downstream of the West Swamp outlet, flow will be directed through an existing culvert under old Highway 10 and westward in the existing channel to Pine Creek.

3.2.3 North Channel (East-West Connecting Channel)

Discharge from the East Swamp is conveyed to the West Swamp via the North Channel. This channel is approximately 2,800 feet long and is located between the north embankment of Page Pond and the railroad embankment. Exposed tailings present in the North Channel, near the existing decant discharge at the northeast corner of Page Pond, will be removed, except where such removal is technically unfeasible or where tailings will be subsequently buried beneath the regraded slopes of the Page Pond embankment and the contaminated soils repository. It is expected that tailings removal from this area may produce a volume of approximately 2,500 cubic yards, which will be disposed of on the West Bench of Page Pond along with other tailings excavated from the West Swamp and West Beach. The removal will result in an increased channel cross section, but should not significantly affect the overall channel gradient or roughness. Upon completion of remedial work, the North Channel will provide sufficient capacity to convey the design flood flow of 127 cfs which results from the 100-year, 24-hour precipitation event.

3.2.4 South Channel (East)

This channel lies along the south side of Page Pond, between the impoundment embankment and old US Highway 10, east of the discharge from Humboldt Gulch. It carries runoff from the highway embankment and from the south embankment of Page Pond, as well as seepage from Page Pond eastward to the East Swamp. The catchment area for this channel is small and, consequently, the flow in the channel is also small. During regrading of the Page Pond embankment slopes, exposed tailings encountered in the channel will be removed, subject to technical feasibility, and transported to the West Bench of Page Pond for final disposal. The channel will be graded and improved, as necessary, to ensure positive drainage. An existing high point, part way between the East Swamp and the discharge from Humboldt Creek, prevents westerly flow from the East Swamp along this route.

3.2.5 South Channel (West)

This channel lies along the south side of Page Pond, between the impoundment embankment and old Highway 10, west of the discharge from Humboldt Creek. In addition to runoff from the highway and the south embankment of Page Pond, as well as seepage from the Page Pond, the channel also receives the flow from Humboldt Gulch and discharges to the West Swamp. This channel will be stabilized and upgraded, as necessary, to convey the peak design flow from Humboldt Creek and local runoff. Riprap will be placed along a portion of the toe of the south embankment of Page Pond, to protect the impingement area against erosive forces resulting from flood events in Humboldt Creek. This riprap blanket will be approximately 18 inches thick with a D_{50} particle size of approximately 12 inches. This riprap thickness and particle size are expected to withstand the erosive forces of the estimated 100-year, 24-hour flood event. The riprap will be placed on a non-woven geotextile filter layer (10 oz./sy minimum), anchored into the north bank of this channel reach, and will extend westward approximately 600 feet from the Humboldt Creek confluence. The riprap blanket will extend up the slope from the toe of the embankment, a minimum of 2 feet vertically, and will be set in a key trench at the toe of the slope to ensure stability (see Figure 3-1). If necessary, a similar riprap blanket will also be placed to protect the toe of the expanded West Bench embankment from erosion.

3.3 PAGE POND COVER FILL AND SLOPE GRADING

The present embankments of Page Pond have slopes as steep as 1.2:1, which, in the absence of a stability analysis, do not satisfy the requirements set out in the Idaho Regulations for Tailings Impoundments, and which are also generally considered to be too steep to allow successful establishment of permanent vegetation. Although these embankments have been stable for many years, they will be regraded to achieve slopes of 2:1 or flatter. Where space allows, such as along the east and much of the north

sides of Page Pond, the embankments will be pushed down from the top to form the new flatter slopes. Along the south side of Page Pond, there is insufficient room at the toe of the slope to permit placement of additional fill. In this area the crest of the embankment will be pulled back to form the flatter slope. It is estimated that approximately 8,000 to 10,000 cy of cut and/or fill will be required to regrade the north, east, and south embankments (See Figure 3-1). The current west embankment of Page Pond will not require regrading. This portion of the impoundment will be buried by the westward extension of the West Bench and will therefore be buttressed and stabilized by new fill material.

The following volume estimates are summarized on Table 2-1; detailed supporting information is provided in Appendix B. Contaminated soils removed during the period from 1990 to 1993 have been disposed of on the East Bench of Page Pond, and are estimated to comprise an insitu volume of approximately 45,000 to 55,000 cy based on inspection. Further contaminated soils will be added to this area until the ultimate capacity of the area is reached (approximately 90,000 cy, assuming a maximum thickness of 6 feet and a surface slope of 0.5 percent). Therefore, it is estimated that the available disposal volume remaining is approximately 35,000 to 45,000 cy. Materials placed on the East Bench will be compacted and graded to promote positive surface drainage. The elongated geometry and the relatively shallow depth of fill on the East Bench do not permit grading such that flow will be across the top of the fill to a single discharge point. Therefore, the surface will be graded to direct flow to a series of smaller discharge points along the east crest of the fill and down the east face to a collector ditch that will convey the accumulated flow to the northeast corner of the impoundment, in the vicinity of the existing decant, where it will enter a reinforced concrete spillway and be conveyed safely down the embankment slope and into the North Channel.

Excavation of tailings from the West Beach, North Channel, and other small areas is expected to produce approximately 30,000 to

40,000 cy of material. This material will be placed on the existing West Bench area and subsequently covered with contaminated soils. It is estimated that approximately 15,000 to 20,000 cy of contaminated soils, previously stored in the IDT facility to the west of the West Swamp, have already been relocated to the West Bench. The total disposal capacity of the West Bench facility, including the expansion is estimated to be approximately 320,000 cy based on a maximum fill thickness of 15 feet, a surface slope of 0.5 percent, and a western embankment sloped at 3:1. Accounting for the contaminated soils already placed there and the anticipated volume of tailings to come, the remaining capacity available for disposal of contaminated soils from future yard remediation activities is estimated to be approximately 260,000 to 275,000 cy. Contaminated soils disposed of in the West Bench repository will be placed and compacted in lifts to ensure stability and to increase the efficiency of space utilization. The contaminated soils will be placed over an extended period of time and, therefore, the final configuration of the West Bench will evolve over a similar period of time. In the interim, it will be necessary to construct temporary drainage control structures to convey runoff flows safely across the interim surface and down the embankment face. Such measures will include appropriate interim grading and a temporary culvert spillway whose position can be adjusted, as needed, to suit the evolving embankment as filling occurs. Grading of the surface of the West Bench fill materials will be an ongoing process as the material is placed, to avoid creation of pockets that might trap runoff and allow excessive infiltration. When placement of material on the West Bench is complete, a permanent berm will be constructed around the perimeter of the embankment crest to restrict sheet flow down the face of the embankment and direct runoff to the discharge point, and a concrete spillway will be constructed. A typical section through the fill area, showing regrading, is presented on Figure 3-1 and the permanent spillway cross-section and details are shown on Figure 3-2.

As shown on Figure 3-1, the new toe of the west embankment will be approximately 200 feet to the west of the present location.

The existing ground elevation at the location of the new toe is approximately 2293 feet AMSL, which is approximately four feet above the weir crest elevation at the outlet from the West Swamp. Therefore, the expanded fill area will not be subject to inundation by flood flows. Because the contaminated soils from which the majority of the expanded West Bench will be constructed likely possess lower strength properties than the materials traditionally used to construct the embankments (e.g., mine waste rock), the perimeter faces of the expanded West Bench will be constructed at a relatively gentle slope of 3(h):1(v) rather than the more steep slope of 2(h):1(v) comprising the minimum State requirement. The embankment crest at the west edge of the expanded West Bench will be at a final maximum elevation of approximately 2225 feet AMSL. This will provide a positive slope away from the crest of the existing PPWTP west embankment of 0.5 percent minimum. If the volume of contaminated soil deposited in the West Bench repository is less than anticipated, the slope of the final closure surface will be steeper than 0.5 percent, but not greater than 1.5 percent to avoid increased erosion potential. The surface of the West Bench fill will be graded to direct runoff toward the northwest corner of the expanded facility, where a spillway will be constructed to safely convey the accumulated drainage down the slope to the North Channel and into the West Swamp.

3.4 LONG-TERM DISPOSAL OF CONTAMINATED SOILS

As shown in Table 2-1, the remaining available capacity for disposal of excavated tailings and contaminated soils on both the East and expanded West Bench of Page Pond is estimated to be approximately 335,000 to 350,000 cy. Allowing for the expected future disposal of tailings (30,000 to 40,000 cy), the remaining disposal capacity of Page Pond is expected to range from 295,000 cy (worst case) to 320,000 cy (best case). The residential areas remediation program is expected to extend over a period of approximately seven years and generate approximately 290,000 cy of soils to be disposed of on the benches (this volume estimate is derived in Section 2.5). These materials will be placed first on

the East Bench, to utilize the remaining capacity there, requiring an estimated 35,000 to 45,000 cy. The East Bench will then be final graded, revegetated and closed. The balance of the contaminated soils from the residential areas remediation program (estimated to be approximately 245,000 to 255,000 cy) will then be placed on the West Bench. Upon completion of the yard remediation program, the filled portion of the West Bench will be graded to its final configuration, revegetated and closed to further materials disposal. It is expected, however, that the entire capacity of the West Bench will not be consumed by the soils from the residential areas remediation program, and the remaining capacity (estimated to be approximately 5,000 to 30,000 cy) will be available, if necessary, for disposal of contaminated soils generated through future construction activities, as affected by the ICP, in the communities. Fill placement operations during the period of the residential areas remediation program will be coordinated such that the capacity remaining upon completion of the program will be conveniently accessible. Should the volume of soils generated after the completion of the residential areas remediation program exceed the nominally remaining capacity, the final grade of the West Bench closure surface could be extended upward to accommodate the additional volume, provided that adequate drainage provisions were made to avoid runoff flowing back into the PPWTP ponds. During the course of placement of soils from the primary residential areas remediation program, volumes of disposed materials will be continually monitored, relative to remaining disposal capacity, and if it appears that the quantity estimates on which the design are based are inaccurate, adjustments will be made to the design to ensure that appropriate residual capacity is left for future ICP disposal requirements.

3.5 EMBANKMENT SOIL COVER AND REVEGETATION

After the existing Page Pond embankment slopes have been regraded, as necessary to improve stability, a minimum 6-inch layer of contaminated soils will be spread over the slopes to provide a suitable growth medium for revegetation. It is estimated that

approximately 5,000 cy of this topsoil will be required for this purpose. This cover layer material will be tied into the contaminated soil fills comprising the East and West Benches, to produce a consistent final cover surface over all areas of the Page Pond area, except those being used for the PPWTP. The entire area will then be planted with native grasses. A cover of 85 percent is expected to be achieved within 3 years for those areas undergoing final closure.

3.6 WETLANDS ENHANCEMENT REVEGETATION

In wetland areas where tailings removal has occurred, such as the West Beach area of the West Swamp, limited plantings of indigenous wetland species will be implemented. Such species could include, but may not be limited to, Scirpus spp. and/or Typha spp. Planting of such species should accelerate overall wetland enhancement. Such plantings will typically consist of a one-time-only effort; if large-scale die-off occurs, additional plantings may be necessary. Locations of plantings will be established based on final designs and will be presented in the Page Pond Remedial Action Work Plan.

4.0 CONSTRUCTION

4.1 TAILINGS EXCAVATION AND PLACEMENT

All tailings removal will take place in the late summer or fall, when the water level in the West Swamp has fallen to its lowest elevation. This work will also be done early in the Page Pond closure schedule so that the excavated tailings can be placed on the West Bench in advance of the majority of the contaminated soils derived from remediation in the residential areas. A temporary berm will be constructed, as necessary, along the edge of any remaining standing water, to prevent reflooding of the West Beach area while excavation of tailings proceeds. Tailings above an elevation of approximately 2,187 feet AMSL will be excavated, to the extent that such excavation is technically feasible, and loaded into trucks for transport to the West Bench. Tailings in other areas of the West Swamp and the North Channel will be excavated during the same time period. In all cases, equipment and construction methodology will be selected and utilized such that existing wetlands are preserved, to the maximum extent practicable.

A temporary haul road and two temporary railway crossings will be constructed north of the railroad embankment, and a temporary ramp will be constructed at the northwest corner of the impoundment, to provide access from the haul road to the top of the Page Pond embankment. Tailings excavated from the West Swamp and the North Channel will be transported along the haul road and up the ramp to the disposal area. No materials excavated from the West Swamp or North Channel areas will be hauled on public roads. Upon completion of tailings removal and placement on the West Bench, the temporary haul road will be removed. A controlled access to the West Bench and West Fan disposal area will be developed to allow ongoing transport of contaminated soils into the facility.

Dust control measures will be implemented during all excavation and regrading operations. These may include the use of

water trucks and/or polymer sprays, applied to the surfaces of haul roads, as well as in excavation and regrading areas, during dry periods.

Tailings material will be placed on the West Bench of Page Pond in lifts approximately 18-inches to 2-feet thick and will be compacted by the normal travel of the earthmoving equipment. When all tailings have been hauled and placed, the areas will be graded to drain toward the northwest corner. Contaminated soils placed subsequently will be similarly spread, compacted and graded. Periodic surveys of the interim surface of the deposited materials will be conducted to identify localized low spots that could allow ponding. The allowable tolerance in the slope of the final grade will be minus 0 and plus 0.5 percent of that designed.

4.2 EMBANKMENT SLOPE REGRADING

The existing embankment slopes will be flattened, as necessary, to a finished slope of 2:1 or flatter, either by constructing a compacted toe fill against the lower portion of the embankment or, where space does not permit, by pulling material from the upper portion of the embankment back up into the impoundment. Standard earthmoving equipment such as scrapers, dozers and hydraulic excavators will be utilized for this work. Where the embankments require layback, a long reach backhoe may be utilized which could be operated from the crest of the embankment. If a structural fill is placed at the toe of an embankment to achieve the desired 2:1 slope, the material will be compacted to achieve a dry density equivalent to 90% of optimum, as determined by the modified Proctor test protocol (ASTM D-1557). Embankment stabilization will be performed in a manner that minimizes disturbance to existing vegetation along the toe of the embankments. As previously described, embankments of the contaminated soil fill area (West Bench expansion) will be graded to slopes of 3:1 or flatter.

4.3 DRAINAGE AND CONTROLS

Runoff spillways, flow control weirs and other drainage works will be constructed using conventional equipment. Because of the relatively small size of the spillways, dimensional tolerances of plus or minus 0.1 foot will be imposed. Construction tolerances for the flow control weirs are less sensitive, because of their larger scale. Dimensional tolerances for these will be maintained in the range of plus or minus 0.5 foot, except that the elevations of the respective weir crests will be held to a tolerance of 0.05 foot. Spillway, ditch, and outlet control weir cross-sections will be confirmed by survey at appropriate intervals to ensure that design tolerances are met.

Construction of modifications to existing channels will be performed so as to limit disturbance to existing wetland vegetation. Riprap along the south channel embankment, west of the Humboldt Creek confluence, will be placed, rather than dumped, on the geotextile filter layer. The allowable thickness tolerance of the riprap blanket will be minus 0 inches to plus 6 inches. The geotextile will be installed such that panels are overlapped a minimum of 18 inches in the downstream or downhill direction.

4.4 FINAL SURVEYING

Upon completion of remedial activities at Page Pond, a Construction Completion Report will be prepared as mandated by the SOW. This report will include as-built drawings showing final details, dimensions and elevations of the closure works. These drawings will be signed and stamped by an Idaho-registered Professional Engineer.

5.0 OPERATION & MAINTENANCE

A plan will be prepared that addresses long-term O&M requirements for all aspects of the Page Pond closure. The plan will identify the specific post-remediation activities required to maintain remedy effectiveness at Page Pond and will include, but may not be limited to:

- operational procedures;
- operational emergency response;
- maintenance procedures and schedules;
- monitoring procedures and schedules;
- long-term biomonitoring (after closure);
- parts and equipment inventory; and
- a plan for demonstrating compliance with the applicable objectives and Performance Standards.

Operation and maintenance activities at the contaminated soils repository portion of Page Pond will continue for at least five years following completion of the residential areas remediation work. The active portion of the repository will become the responsibility of the ICP. As such, the ICP developed for the Bunker Hill Superfund Site is expected to accomplish the long-term operations and maintenance requirements for the remediation activities addressed by this RDR.

5.1 COVER LAYER

The cover layer of the Page Pond closure will be inspected regularly during the post closure period, primarily to detect localized differential settlement and erosion. Regular inspections will be performed on a semi-annual basis and after major storm events, during the first three years following closure. The inspections will include assessments of vegetative cover on the

final closure cap to evaluate whether the 85 percent cover criterion has been achieved.

Some maintenance may be required if unanticipated conditions develop that may inhibit the performance of the remedial action. Areas of the covers or embankments where loss of vegetation from sheet, rill, or gully erosion is detected will be restored with new soil and reseeded. Repair of runoff control berms around the perimeter of the covers will also be performed, if required. Any areas of the closure showing evidence of ponding following precipitation events, or differential settlement which may inhibit free drainage, will be filled with borrow soils, regraded and reseeded.

Five years after closure, if no additional erosion or settlement problems are encountered, inspection frequencies will be reduced to once per year, with additional, unscheduled inspections following major storm events.

5.2 DRAINAGE AND CONTROLS

Drainage and control facilities, including runoff spillways, ditches, and control weirs will be inspected on a semi-annual basis and after significant precipitation events for the first five years following closure. The frequency may then be reduced to once per year. They will be inspected for erosion, displaced riprap or gabions, loss of vegetation, slope sloughing, or debris deposition in ditches.

Periodic maintenance procedures may include removal of debris from ditches, repair of eroded or sloughed areas, repair of displaced riprap (or gabions) and reseeding, if required.

6.0 ENVIRONMENTAL MONITORING AND REPORTING

Monitoring of the Page Pond closure area will include assessment of selected water chemistry, sediment chemistry, and biological parameters. The monitoring program is summarized in Table 6.1 and is discussed below.

6.1 WATER CHEMISTRY

Surface drainage inflow and outflow locations will be monitored for lead, cadmium, zinc, arsenic, and total suspended solids (TSS). Water samples will be analyzed for total and dissolved metals according to standard methods (EPA, 1986). Sampling locations will be:

Inflow stations:

- Grouse Creek at inflow to East Swamp; and
- Humboldt Creek at inflow to West Swamp.

Outflow stations:

- Outlet of East Swamp to North Channel;
- Outlet of West Swamp at flow control structure upgradient of Pine Creek.

Sampling will occur twice per year in the year prior to remediation and in the first five years following remediation. Sampling will occur in:

- Spring during high flow period; and
- Fall during low flow period.

6.2 SEDIMENT AND SOIL CHEMISTRY

Sediments and soils in East and West Swamps will be sampled and analyzed to assess concentrations of lead, zinc, cadmium and arsenic. The sampling transects presented in the Page Pond Soil

Sampling Results report (Appendix A) (T-series transects only) will be replicated. A further transect (to be identified as T-0) will be sampled at the location of transect D-2, in order to ensure that sampling extends over the full length of the West Swamp. The transect locations will be permanently located, with surveyed marker posts, to facilitate sampling replication. Chemical analyses for analytes will be accomplished by standard methods as outlined in the Page Pond Soil Sampling Results report (Appendix A). Sediments will be sampled using a hand auger (3-inch diameter) or, preferably, a hollow core push-tube type sampler, along the specified transects according to the scheme reported in Appendix A, with the exception that only the 0- to 3-inch and 3- to 6-inch depths will be sampled. This total sampling depth corresponds to the primary biologically active zone of wetland sediment. Samples of material from the litter layer will be analyzed separately from underlying soils and sediment. Visual observations as to the thickness of the litter layer will also be made. Sediments and soils will be sampled twice: once as soon as practical after site closure and again in five years.

6.3 BIOMONITORING

Biomonitoring will be conducted at the Page Pond closure site to:

- assess changes in wetland habitat conditions resulting from the wet closure action; and
- document that site ponds and wetlands are not attractive nuisances to wildlife due to the presence of lead, zinc, cadmium or arsenic.

The proposed biomonitoring program will document the following site characteristics:

- dominant vegetation and percent cover on the basis of water depth or substrate type (e.g., rock, silt, etc.), including the apparent health of dominant vegetation;

- relative population abundances and metal body-burdens of resident wild rodents;
- the species composition and apparent health of nesting songbirds; and
- the species composition, nesting success and apparent health of resident waterfowl.

The biomonitoring program will be conducted by a qualified biologist and will be qualitative to semi-quantitative. Interpretation of field data will rely to a certain degree on best scientific judgement to assess monitoring results in relation to site closure objectives. This standard practice has been used elsewhere in USEPA-sponsored ecological effects assessment programs (e.g., ETI, 1993). The biomonitoring program will begin in the year prior to remediation and will be conducted in each year during the initial five year post-closure period. As shown on Table 6-1, vegetation and wild rodents will be monitored once per year whereas birds and waterfowl will be monitored twice per year. A five-year time frame is sufficient for a mature wetland system to develop and for any unanticipated ecological effects to become manifest.

6.3.1 Reconnaissance Survey of Vegetation

A general vegetation reconnaissance survey at the Page Pond closure area (Page tailings impoundment and East and West Swamps) will begin in the year prior to remediation and will continue once each year for the first five years post-closure. The survey will be conducted according to standard field techniques (e.g., Kuchler and Zonneveld, 1988). Aerial photographs with field truthing will be used to prepare appropriate vegetation maps. The primary requirement for annual overflight photography is that it must be done each year during the peak biomass period of late July to early August before leaf-fall occurs. If annual aerial photography of the site already is included in the hillsides revegetation surveys to be conducted by others, a blowup of the Page Pond area from the master photograph will be produced by the Settling Defendants. If

not available, a low-elevation photographic survey of Page Pond will be conducted by the Settling Defendants.

Aerial photography and field data analyses will include an assessment of:

- aerial distribution of dominant habitat types;
- description of dominant vegetation within habitat types; and
- an estimate of relative percent cover (0 - 25 percent, 25 - 50 percent, 50 - 85 percent and 85 - 100 percent) for each habitat type.

Dominant habitat types will be determined, in part, by physical characteristics such as water depth and substrate type. These data will be compared to nearby reference sites having an equivalent stage of vegetation maturity. Qualitative ground truthing will be conducted to verify the maps generated from aerial photographs. The apparent health of dominant vegetation in Page Pond system will be visually determined and documented at that time. Plant health will be evaluated from relative plant height, general vegetation color (e.g., signs of plant stress such as chlorotic conditions), and any other obvious condition including the presence of plant pests (defoliating caterpillars, etc.). These observations will be recorded in field notebooks and summarized in the field reports.

6.3.2 Survey of Resident Wild Rodents

A survey of wild rodents at the Page Pond closure area will begin in the year prior to remediation and will continue once each year for the first five years post-closure. The objectives of monitoring wild rodents at Page Pond will be to monitor their metal-body burdens and to demonstrate that the wet closure habitat contains normal rodent populations. The analytes to be monitored will include lead, cadmium, zinc and arsenic.

Wild rodents will be trapped over a minimum of three trap nights during the peak population period from approximately late July through mid-August. Approximately 25 live traps will be used per acre of viable habitat according to standard field techniques. Traps will be equally distributed among habitat types to survey a representative selection of habitats and resident rodents. Trapping success will be recorded for each habitat type and trap number to obtain relative population abundance information. Approximately ten small rodents (mice and voles) will be randomly selected from the total catch and sacrificed for analysis of body-burdens.

Individual rodents will be analyzed using standard clean laboratory technique as follows. Of the approximately ten individuals collected, three will be randomly selected and dissected to determine the percent body burdens found in muscle, viscera, and hard body parts (bone, skin, fur). The remaining seven individuals will be processed for whole-body burdens.

Results of the trapping effort and laboratory analyses of metals will be compared to nearby reference sites. Reference sites will be comparable in terms of community structure or type of habitats and will include information from the Milltown Reservoir, MT, site where an extensive study of rodents and associated tissue residues has recently been conducted (ETI, 1993).

6.3.3 Survey of Song Birds

While use of the wet closure area by songbirds is expected to parallel the development of vegetation structural habitat, bird species diversity and presence of breeding pairs are useful indicators of system ecological health as found elsewhere in metal-enriched wetlands (ETI, 1993). Therefore, a site reconnaissance survey will be conducted twice each year during the year prior to remediation and for the first five years post-closure to document use of the Page Pond closure area by songbirds. The timing of the

surveys will encompass the peak nesting period and will include early spring and early summer.

Routine bird surveys of the site will be conducted using the stratified random transect method according to standard field techniques. Each survey will determine the bird species composition and will provide information to estimate semi-quantitatively the average densities encountered in dominant habitat types. Special attention will be made to nesting birds, and songbird nests will be counted while running the transect surveys. While the survey is being conducted, the field crew will record the number of sick or dead birds observed according to species. These field observations will be compared to typical ranges of such data for riparian/wetland sites found regionally.

6.3.4 Survey of Waterfowl Nesting Success

A routine reconnaissance survey of waterfowl use of the Page Pond closure area will be conducted using the stratified random transect method according to standard field techniques. As possible, these surveys will be done simultaneous with the songbird surveys, as described above. Two nest counts will be made each year: early in breeding season (typically mid-spring) to catch the early nesting individuals (April-May) and in early summer (June) to catch later nesting birds. While the survey is being conducted, the field crew will record the number of sick or dead waterfowl observed according to species. Field observations on waterfowl nesting success and apparent health of individuals observed will be compared to typical ranges of such data for riparian/wetland sites found regionally.

6.4 LONG-TERM MONITORING

Long-term monitoring may be necessary after completion of the initial five-year monitoring program. The requirement for long-term environmental monitoring of the Page Pond closure area by the Settling Defendants is dependent upon the following considerations:

- The discharge of PPWTP effluent to the swamp closure area;
- The results of the initial five years of monitoring; and
- The requirements for monitoring imposed upon the PPWTP under NPDES.

As noted previously, it is anticipated that the wet closure system will reach maturity within five years of closure completion. Given this assumption, water quality and general wetland conditions would be controlled by the discharge of PPWTP effluent to the system, should this option be implemented. If monitoring results for the initial five years indicate system maturation and stability, and the NPDES monitoring requirements are in place, additional monitoring may not be required. The EPA, IDHW, and Settling Defendants will review the final monitoring report for the initial five-year period, considering the above conditions, to determine what future monitoring, if any, is required. If long-term monitoring is required, portions or all of the program defined above will be implemented once during every five years for an additional 15 years following the first five-year post-closure monitoring period. Under this scenario, the overall program will be carried on for 20 years post-closure.

6.5 REPORTING REQUIREMENTS

A Page Pond Annual Monitoring Report will be prepared for each year that site monitoring is conducted. The report will include all field data collected during the previous calendar year and appropriate analyses. The report will include:

- data collected with tabular and graphical presentations;
- comparisons of site data to similar data from reference systems; and
- comparisons of most recent monitoring data to previous years data for the site.

The annual report will be delivered to appropriate agencies within 90 days of the end of the sampling season. If it is determined that additional monitoring is required, beyond the first five-year period, monitoring reports will be submitted within 90 days of the end of each sampling season.

7.0 FUTURE DELIVERABLES (PLANS AND REPORTS)

The following described plans and reports will be submitted to IDHW and/or EPA for the Page Pond Element of Work in Area I.

7.1 GENERAL PROJECT MANAGEMENT

7.1.1 Project Management Monthly Reports

Monthly reports submitted pursuant to Section XI of the Consent Decree will include a section on the Page Pond Element of Work when applicable. The Page Pond section will include the following basic information:

- General description of the work.
- Activities/tasks undertaken during the reporting period, and expected to be undertaken during the next reporting period.
- Identification of issues and actions that have been or are being taken to resolve the issues.
- Status of the Page Pond remediation schedule and any proposed schedule changes.

7.1.2 Technical Memoranda

Technical memoranda are the mechanism for requesting modification of plans, designs, and schedules. Technical memoranda will not be prepared or required for non-material field changes that have been approved by the agencies. In the event that the Settling Defendants determine that modification of an approved plan, design, or schedule is necessary, the Settling Defendants will submit a written request for the modification to the Agency Project Coordinators which will include, but will not be limited to, the following information:

- General description of and purpose for the modification.
- Justification, including necessary calculations, if any, for the modification.
- Actions to be taken to implement the modification, including any actions related to subsidiary documents, milestone events, or activities affected by the modification.
- Recommendations.

7.2 REMEDIAL DESIGN

Further design report beyond this Draft RDR will consist of the following:

7.2.1 Final Remedial Design Report

After completion of field surveys of the embankments and various creek channels, including confirmation of weir crest elevations relative to the current water levels and elevations of tailings in the West Beach and West Fan areas, this RDR will be upgraded into a Draft Final RDR with the addition of drawings showing existing and proposed cross sections at regular intervals (ie: every 200 feet) around the embankments and along the various channels. The Draft Final Page Pond RDR will be submitted to the agencies by September 1, 1994.

Upon receipt of comments and requested modifications from EPA and the State of Idaho, the Draft Final Design Report will be appropriately revised and will be resubmitted as a Final RDR. This report will include all the elements contained herein, plus:

- design drawings;
- design specifications;
- design calculations;
- design quality assurance considerations

- general design concept and criteria of facilities to be constructed;
- descriptions of existing facilities and identification of any that will be altered, destroyed, or abandoned during construction;
- descriptions of off-site facilities required or affected;
- analysis/discussion of Performance Standards and how they have been incorporated into the design; and
- design parameters dictated by the Performance Standards.

No further design reports will be required beyond the submittal of the Final RDR.

7.3 REMEDIAL ACTION

7.3.1 Page Pond Remedial Action Work Plan

Following completion of the remedial design phase, the Settling Defendants will submit a work plan outlining the proposed Page Pond closure remediation activities. A draft of this work plan will be submitted to the agencies by March 1, 1995. Agency comments on the draft work plan will be addressed in the Final Page Pond Remedial Action Work Plan. At a minimum the Final Page Pond Remedial Action Work Plan will include:

- the scope of proposed remediation;
- a map showing areas proposed for remediation during construction season;
- a remediation schedule for construction season;
- any deviations or changes from work tasks or procedures outlined in the Final Page Pond RDR;
- a plan for coordinating, integrating, and communicating with various agencies;
- a description of deliverables and milestones during construction season; and

- a discussion of any health and safety issues particular to Page Pond.

7.3.2 Health and Safety

As noted in the SOW, a Remedial Action Health and Safety Plan will be prepared that comprehensively addresses construction work in Area I. Health and safety issues specific to the Page Pond Element of Work will be addressed in the Page Pond Remedial Action Work Plan. As noted above, a draft of this work plan will be submitted for agency approval prior to the commencement of remediation activities. The health and safety portion of the Remedial Action Work Plan will include a description of any monitoring activities to be undertaken during remediation of the Page Pond.

7.3.3 Construction Completion Report

The Construction Completion Report will be submitted 60 days following the completion of construction activities at Page Pond. The report will provide evaluations of Completion of Work, relative to the scope outlined in the Final Page Pond Remedial Action Work Plan. The Construction Completion Report will include, but will not necessarily be limited to the following:

- an overall description of the Report, including its purpose, and an overall description of the Work covered by the Report;
- an overall description of the construction components of the Work, and all associated facilities, appurtenances, and piping; and
- as-built plans and specifications, including:
  - construction QA/QC records; and
  - summaries of any modifications implemented by Technical Memoranda.

An Idaho-registered Professional Engineer will sign and stamp as-built plans for the Page Pond Element of Work.

7.3.4 Post-Closure O&M Plan

The Post-Closure O&M Plan for Page Pond will address the specific post-remediation activities required to maintain the effectiveness of the remedy. The Plan will address, but will not necessarily be limited to:

- operational procedures;
- operational emergency response;
- maintenance procedures and schedules;
- monitoring procedures and schedules;
- parts and equipment inventories;
- plan for demonstrating compliance with Performance Standards; and
- long-term biomonitoring issues.

7.3.5 Page Pond Annual Monitoring Reports

Reports presenting the results of ongoing monitoring activities at Page Pond will be prepared annually, within 90 days following the conclusion of the sampling season. The reports will include, but will not necessarily be limited to the following:

- results of sediment and water quality monitoring, conducted as specified in Section 6.0;
- results of biomonitoring, conducted as specified in Section 6.0; and
- a brief evaluation of the data from the current year, relative to historical data and biomonitoring data from similar areas in the region.

8.0 CERTIFICATION OF COMPLETION OF REMEDIAL ACTION

A Pre-Certification Inspection will be conducted within 90 days of concluding that the Performance Standards have been attained for the Page Pond Element of Work. Within 30 days of the Pre-Certification Inspection, a Completion of Remedial Action Certification Report will be submitted to IDHW and EPA. This Report will serve as the Settling Defendants' documentation supporting the completion of remedial actions and achievement of Performance Standards at the Page Pond and their request for certification from the agencies. The Report will include, but will not necessarily be limited to:

- an overall description of the Report, including its purpose, and a general description of the Page Pond area, including the Components of Work addressed by the Report;
- findings of the Pre-Certification Inspection, including documentation supporting the claim that the applicable Performance Standards have been attained;
- cross references to as-built drawings in the Construction Completion Reports, as appropriate;
- demonstration that all obligations for the Page Pond Element of Work, as presented in the SOW and the Consent Decree, have been satisfactorily achieved by the Settling Defendants, in accordance with the Consent Decree;
- a statement by the Settling Defendants' Project Coordinator that remedial action has been completed in full satisfaction of the requirements of the Consent Decree; and
- a statement by an Idaho-registered Professional Engineer that the remedial action at Page Pond is in full satisfaction of the requirements of the Consent Decree.

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TABLES

TABLES

Table 2-1

SUMMARY OF ESTIMATED AVAILABILITY AND UTILIZATION
OF DISPOSAL CAPACITY ON PAGE POND BENCHES

	East Bench (existing)	West Bench (existing)	West Bench (expansion)	Total
	(Volumes x 1,000 cubic yards)			
Original Capacity	90	220	100	410
Contaminated Soils Deposited to Date	45 - 55	15 - 20	--	60 - 75
Remaining Capacity	35 - 45	200 - 205	100	335 - 350
Expected Future Disposals				
- tailings	--	30 - 40	--	30 - 40
- contaminated soils	35 - 45	145 - 155	100	290
Remaining Capacity for ICP	0	5 - 30	0	5 - 30

Note: Assumptions and calculations supporting the volume estimates are provided in Attachment B.

Table 2-2

RESULTS OF HELP MODEL RUNS FOR PAGE POND

Remedial Action Alternative	Annual Precipitation (inches)			Annual Vertical Percolation Rate Through Cover System (inches)			Annual Volumetric Percolation Through Cover System (cubic feet)			Percent Percolation Through Cover System (of total annual precipitation)		
ALTERNATIVES 3 & 4	DRY	NORM	WET	DRY	NORM	WET	DRY	NORM	WET	DRY	NORM	WET
Page Pond Dikes Covered with Soil and Revegetated	19.08	30.31	41.11	7.02	15.12	26.56	1018840	2195699	3856438	36.78	49.89	64.61

Ksat Saturated Hydraulic Conductivity of the Barrier Liner

Dry Annual precipitation for "dry conditions" is actual Kellogg, Idaho precipitation data for 1948 (1950 in Appendix B model runs), the driest year of the period of record (1919 - 1989)

Norm Annual precipitation for "normal conditions" is average of 20 years of Kellogg, Idaho actual daily precipitation data from 1933 - 1954 (minus years with incomplete data: 1942 and 1947)

Wet Annual precipitation for "wet conditions" is actual Kellogg, Idaho precipitation data for 1933, the second wettest year for the period of record (1919 - 1989). The second wettest year was used because it occurred within the 20 year data set used for the HELP model runs.

Table 6-1

Sampling Strategy for the Page Pond Area

Monitoring Element	Frequency (times/yr)	Duration[a] (years)	Activity
Water Chemistry	twice	year prior to remediaton, then for the first five years post-closure	Chemical monitoring of selected inflow/outflow locations for total and dissolved Pb, Zn, Cd, and As and for TSS.
Sediment Chemistry	once	once in first year post-closure and once after 5 years post-closure	Assessment of total sediment concentrations of Pb, Zn, Cd and As.
Vegetation	once	year prior to remediation, then first 5 years post-closure	Vegetative mapping; relative percent cover; ground truthing apparent health of vegetation.
Wild Rodents	once	year prior to remediation, then for the first five years post-closure	Trapping: 3 nights w/ 25 traps/night-ac.; relative species abundance; whole body burdens of Pb, Zn, Cd and As in 7 individuals; selected tissue burdens for 3 individuals
Birds	twice	year prior to remediation, then for the first five years post-closure	Reconnaissance survey; species presence; relative abundances; # of nesting pairs; apparent health of birds observed.
Waterfowl	twice	year prior to remediation, then for the first five years post-closure	Reconnaissance survey; species presence; relative abundances; # of nests; apparent health of birds observed.

a If the PPWTP discharge is not directed to the swamp, these listed monitoring activities will be implemented once every five years for an additional 15 years following the first five-year post-closure period.

J:\2339\T6-1.TBL

FIGURES

FIGURES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WA 98101

TARGET SHEET

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Document Information

Document ID #: 1208021
File #: 10.9.4.2 VOL 2
Site Name: BHSF

FIGURE 2.1
PAGE POND CLOSURE

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SEATTLE, WA 98101

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Site Name:	BHSF

FIGURE 2.2
PAGE POND CLOSURE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WA 98101

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Document Information

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Site Name: BHSF

FIGURE 3.1
RECLAMATION PLAN
PAGE POND CLOSURE CROSS SECTIONS

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Document ID #: 1208021
File #: 10.9.4.2 VOL 2
Site Name: BHSF

FIGURE 3.2
SPILLWAY DETAILS

APPENDIX A

APPENDIX A

PAGE POND SWAMP

SOIL SAMPLING RESULTS

JULY 1993

Prepared for:

ASARCO Incorporated
P.O. Box 440
Wallace, Idaho 83873

Prepared By:

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524 Bank St., Suite 207
Wallace, Idaho 83873
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1.0 INTRODUCTION

1.1 Background and Location

Page Pond's East and West Swamps are located at the western end of the Silver Valley between Smelterville and Pinehurst. The community of Page lies to the south and the old Union Pacific Railroad bounds the site on the north. Interstate Highway 90 and the South Fork of the Coeur d'Alene River are on the north side of the railroad approximately 1/4 and 1/2 mile respectively, north of the East and West Page Swamps (Figure 1-1). The Page Swamp area exists to the east and west of the Page tailing impoundment. The Page Pond Water Treatment Plant (PPWTP) situated on top of the Page tailing impoundment, divides the two swamp areas.

The PPWTP was built on top of the old Page tailing impoundment after 1972 when the Seattle First National Bank as Trustee for Mine Owners Association (MOA) transferred title of the Page tailings impoundment to the South Fork Coeur d'Alene River Sewer District. Previously, from 1926 to 1968, the Page tailing impoundment received tailings in the form of a slurry from the flotation mill at the Page mine. Prior to 1939, the tailings were discharged in an uncontrolled fashion, as shown in Figure 1-2, between the existing railroad grade and the south edge of the floodplain where Highway 10 is currently located. Construction of an embankment was begun in 1939 to contain the tailings from the Page mill. It appears portions of the embankment were built on top of the slimes from the previous uncontrolled tailings deposits (Gross, 1982).

The Hayes Company Mill operated from 1918 to 1929 and processed jig tailings from material deposited in the Smelterville Flats area (Engineering and Mining Journal, 1918; Thirty First Annual Report of the Mining Industry of Idaho for the Year 1929, 1929). The Hayes mill was located on the west side of the existing Highway 10, at the western end of the West Page Swamp. The mill was a 100-ton flotation concentrator and was treating approximately 30 to 40 tons per day of tailings during startup in 1918. The mill was operated through the early part of 1929 at which time the tailings being reclaimed were exhausted. The operation was suspended and the mill was dismantled. Tailings from this mill were discharged into the area east of the mill and south of the railroad embankment.

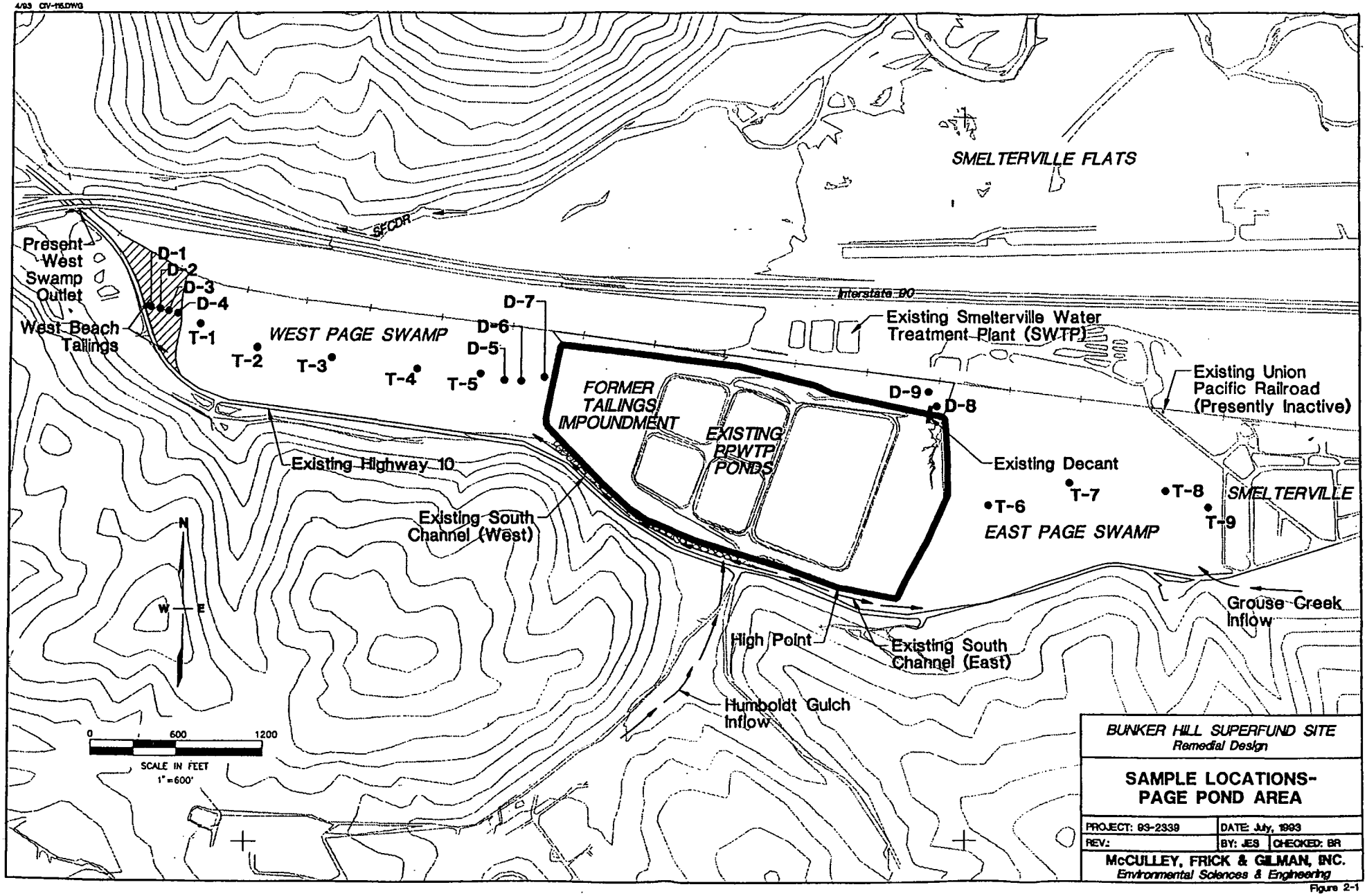

4/93 CIV-115.DWG
SMELTERVILLE FLATS
SFCDR
Interstate 90
Present West Swamp Outlet
West Beach Tailings
D-1
D-2
D-3
D-4
T-1
T-2
T-3
T-4
T-5
D-5
D-6
D-7
WEST PAGE SWAMP
Existing Smelterville Water Treatment Plant (SWTP)
Existing Union Pacific Railroad (Presently Inactive)
FORMER TAILINGS IMPOUNDMENT
EXISTING PPWTP PONDS
D-9
D-8
Existing Highway 10
Existing Decant
T-6
T-7
T-8
T-9
SMELTERVILLE
EAST PAGE SWAMP
Existing South Channel (West)
Grouse Creek Inflow
High Point
Existing South Channel (East)
Humboldt Gulch Inflow
N
W
E
0
600
1200
SCALE IN FEET
1"=600'
BUNKER HILL SUPERFUND SITE
Remedial Design
SAMPLE LOCATIONS-
PAGE POND AREA
PROJECT: 93-2339
DATE: July, 1993
REV:
BY: JES
CHECKED: BR
McCULLEY, FRICK & GILMAN, INC.
Environmental Sciences & Engineering

Figure 2-1

1.2 Objective and Scope

This report presents the results of site assessment activities performed at the Page Pond Area (Figure 1-1). The purpose of this assessment was to estimate the lateral and vertical extent of mine waste tailings through chemical analysis of lead content and by visual observation of hand augered soil samples. These data will be used to support decisions regarding remedial actions, including possible excavation, in the East and West Page Swamp areas.

The plan developed for this work is presented in Appendix A. Comments to the work plan were issued by the U. S. Environmental Protection Agency (USEPA) in an April 29, 1993 letter (Appendix B); the program was modified to address these concerns.

2.0 SAMPLING AND ANALYSIS

This section presents a summary of a sampling and analysis performed for the investigation, including descriptions of sample locations, field sampling methods, and laboratory analytical methods. In addition, deviations from the sampling methodology presented in the work plan are discussed; these changes resulted from USEPA's comment letter (Appendix B).

2.1 Sample Locations

The characterization of soils was performed by a two-part sampling effort. The first part, with locations designated as "T" sample points, involved shallow depth sampling (less than or equal to 3 feet) followed by logging of the boring and chemical analysis of soils for lead content. The second part engaged the use of a hand auger to retrieve soil samples (until auger refusal or soil samples could not be recovered due to water and soil conditions or limited depth access due to length of sampling equipment) for visual identification of soils and flotation tailings; these soil samples have "D" prefixes indicating their sample locations.

Nine "T" soil borings were taken from the approximate locations shown on Figure 2-1 . Five locations (T-1 through T-5) were sampled on the west side and four soil locations (T-6 through T-9) were sampled on the east side of the existing Page tailing impoundment. Originally only 8 locations were to be sampled, however, the USEPA requested an additional sample location at the eastern part of the East Page Swamp (Appendix B). Field logs of the hand augered borings for the "T" and "D" locations are presented in Appendix C and D, respectively.

A total of nine "D" sites were characterized by visual observation of the hand augered soils (Figure 2-1). Four of the sites were at the western end (D-1 through D-4) and three of the locations (D-5 through D-7) were at the eastern end of the West Page Swamp. The USEPA requested that a transect of "depth" samples be secured in the vicinity of the east bench decant line (Appendix B). Therefore, locations D-8 and D-9 were also evaluated to satisfy the USEPA's requested east bench decant line samples.

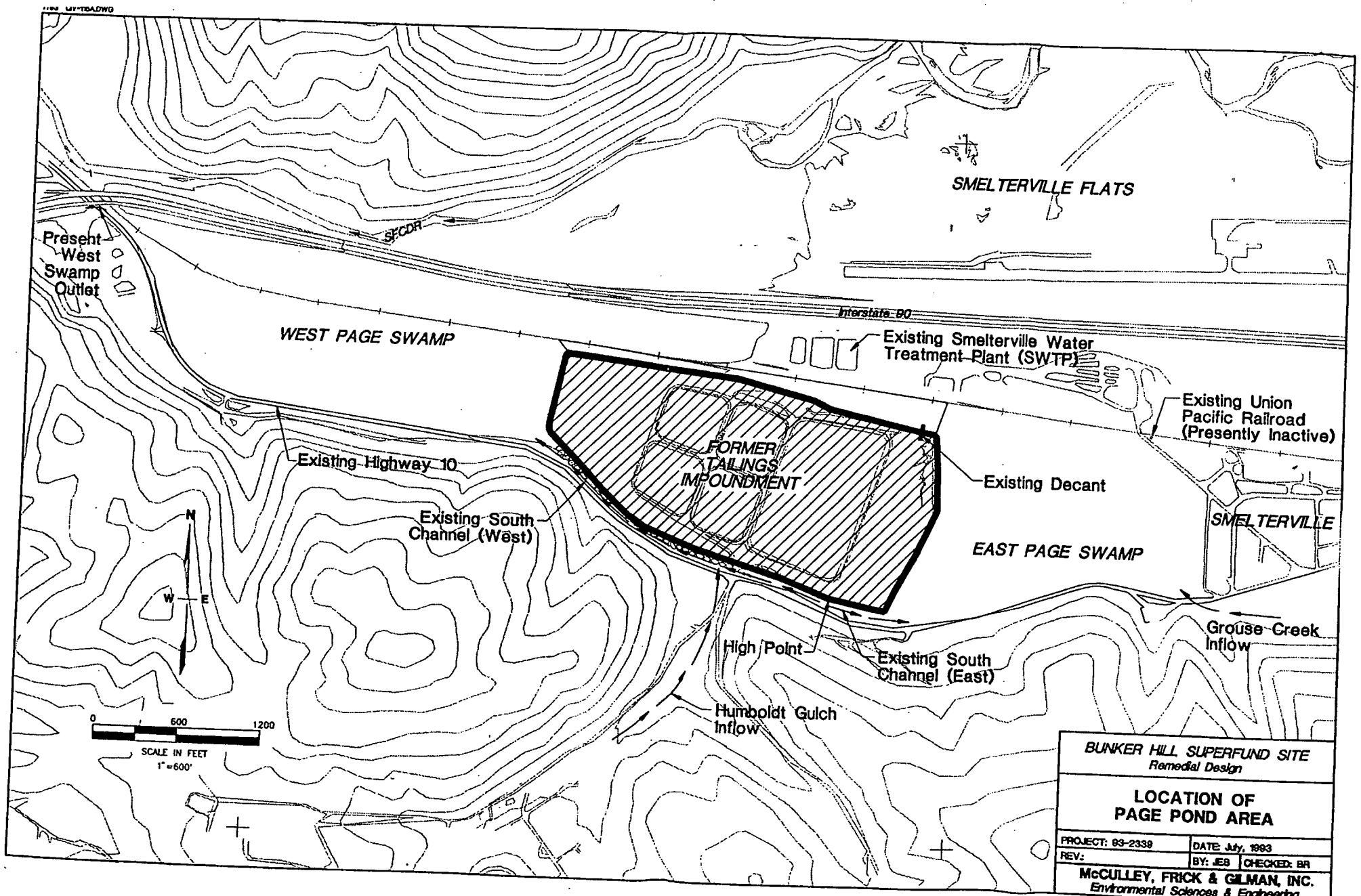

SMELTERVILLE FLATS
SFCDR
Present West Swamp Outlet
Interstate 90
WEST PAGE SWAMP
Existing Smelterville Water Treatment Plant (SWTP)
Existing Union Pacific Railroad (Presently Inactive)
FORMER TAILINGS IMPOUNDMENT
Existing Highway 10
Existing Decant
Existing South Channel (West)
SMELTERVILLE
EAST PAGE SWAMP
Grouse Creek Inflow
High Point
Existing South Channel (East)
Humboldt Gulch Inflow
N
W
E
0
600
1200
SCALE IN FEET
1"=600'
BUNKER HILL SUPERFUND SITE
Remedial Design
LOCATION OF PAGE POND AREA
PROJECT: 93-2339
DATE: July, 1993
REV.:
BY: JES
CHECKED: BR
McCULLEY, FRICK & GILMAN, INC.
Environmental Sciences & Engineering

Figure 1-1

2.2 Field Sampling Methods

The "T" soil sample locations were located by determining the distance of the locations from known features as shown in the work plan's site map. The locations were then sited using a 300- foot measuring tape in the field. Sampling was performed using a 3 inch diameter hand auger with a combination of one 4 foot and two 3 foot sections of extensions to retrieve the soil from the designated sampling intervals of 0 to 3 inches, 3 to 6 inches, 6 to 18 inches and 18 to 36 inches for T-1 through T-5, and for the 0 to 3 inches, 3 to 6 inches, and 6 to 18 inches depth intervals for T-6 through T-9. The additional soil sampling interval from 18 to 36 inches for T-1 through T-5 was proposed by the USEPA (Appendix B). Soil samples were placed in ziplock bags, labeled and placed in an ice chest. The samples were delivered to Silver Valley Laboratories Analytical, Inc. (SVL) in Kellogg, Idaho with completed chain-of-custody reports. T-10 was a duplicate of T-5, submitted to SVL for QA/QC purposes.

The "D" sample locations were sited in the same manner as were the "T" soil sample locations. Sample locations were chosen that would provide the optimum amount of information regarding the lateral and vertical extent of tailings. The soil samples were retrieved with a hand auger and visually characterized and logged. Each boring was excavated to the depth at which auger refusal was encountered or until soil samples could not be recovered due to water and soil conditions or due to limitations of depth access because of the length of the auger.

The sampling equipment that came in contact with the soil was decontaminated prior to each location and between each vertical sampling interval. The soils were washed off the equipment first, followed by wetting the equipment with a phosphate-free cleaning soap and distilled water solution and scrubbing with a bristle brush. The equipment was then rinsed with distilled water. The decontamination soap solutions and rinse waters were disposed of on the ground surface.

2.3 Laboratory Analytical Methods

The laboratory analyses of soil samples were performed by SVL. A total of 36 soil samples were collected in the East and West Page Swamp areas and submitted for analysis. Each soil sample was tested for total lead using SW-846 Method 7420.

The laboratory analysis results of the soil samples are presented in Table 1-1. The laboratory

report and chain-of-custody documentation are presented in Appendix E.

2.4 Deviations From Work Plan

The letter dated April 29, 1993 from the USEPA, Region 10 (see Appendix B) lists comments regarding the work plan. The letter from the USEPA requested that the soil samples be composited before analysis. The soil samples were not composited as requested. The USEPA's oversight person from SAIC was questioned about the soil being composited and after contacting the USEPA informed the sampling team that the soil was not to be composited, except for each discrete vertical sample interval (i.e. 0-3 inch) only for each individual sample location.

A sliding drop hammer was proposed to be used to sample the "T" soil sample locations. Due to the increase in depth for sampling proposed by the USEPA and on-site water conditions a hand auger was substituted in place of the drop hammer. Bill Hudson from the USEPA oversight group, SAIC, was notified of this deviation from the work plan.

3.0 RESULTS

Results of the investigation are presented in this section. Both visual observations and analytical results are discussed.

3.1 Visual Observation

Borings T-1 through T-5 were all hand augered to a maximum depth of 36 inches. Boring T-1 had tailings (a red silt to silty sand that became gray in color with increased depth) present from the surface to 36 inches below the ground surface. Boring T-2 had tailings (orange to orangish brown, silty sand to silt) from 0 to 6 inches below the surface and a light brown silt from 6 to 36 inches below the surface. Boring T-3 had an organic layer from 0 to 4 inches below the surface, followed by tailings consisting of a reddish brown silty sand from 4 to 6 inches. The depth interval of 6 to 18 inches in location T-3 consists of a mixture of tailings and native silty sands. A light to medium brown silty sand native soil with some orangish red mottling occurs at the 18 to 36 inch interval of T-3. Both T-4 and T-5 had a layer of decomposing organics mixed with a reddish orange silty sand (tailings) from approximately 0-6 inches. From 6 to 36 inches, tailings consisting of orangish red silty sand to silt material were noted in the borings. Field logs of each boring (Appendix C) present a description of the varying soil types and conditions.

Borings T-6 through T-9 were hand augered to a depth of 18 inches. The borings of T-6 through T-9 had relatively consistent soil characteristics. The 0 to 6 inch interval for these borings consisted of a dark brown organic layer with minor amounts of a tan silt, except at T-8 where there is a greater amount of tan silt and less organics in place. From 6 to 18 inches, the four borings consist of native soils composed of a light brownish gray silt. Field logs of borings T-6 through T-9 are presented in Appendix C. Above ground surface conditions are described in the lower comments section of the boring logs.

To estimate the depth of tailings through visual observation, nine boreholes were hand augered at nine locations D-1 through D-9, shown on Figure 2-1. A maximum of 10.7 feet and a minimum of 6.5 feet of soil was logged with a hand auger. These depths were influenced by the following factors: the maximum depth obtainable with the hand auger was 10.7 feet, refusal due to gravel or other obstructions and characteristics of the soil and water influencing the ability to retrieve the sample in the augers core barrel.

The western most area of the West Page Swamp, adjacent to Highway 10, had four (D-1 through D-4) borings hand augered to depths ranging from 7.8 to 10.7 feet. Soils from the surface to the maximum auger depth sampled, consisted of fine grained (fine sand to silt) tailings. The depth of the tailings may be deeper than the maximum sampling depth of 10.7 feet.

The borings hand augered at the east end of the West Page Swamp (D-5, D-6 and D-7) had silty sand to silt tailings present to a depth of 7.5 feet. All three borings had auger refusal due to gravel, therefore, tailings may be deeper then 7.5 feet. The soil from approximately the 3 to 6 foot interval consisted of a soft silt that exhibited medium to high plasticity at both the east and west areas of the West Page Swamp.

The area hand augered at the east beach decant line indicated tailings in boring D-8 from 0 to 6.5 feet and from 0 to 8 feet in boring D-9. Boring D-8 had auger refusal at 6.5 feet due to gravel. D-9 had soil conditions that inhibited recovery of soil samples below 8 feet in depth. Therefore, tailings may exceed these maximum observed depths.from 6.5 to 8 feet in depth. The detailed borehole logs for this area are presented in Appendix D.

3.2 Analytical Results

Detectable lead concentrations were identified within all nine "T" soil sample locations (Table 1-1) ranging from 70 to 33,300 parts per million (ppm) lead. Hayes Mill tailings at the west end of the West Page Swamp contained the highest concentrations of lead, ranging from 15,200 to 33,300 ppm. Page Mill tailings at the east end of the West Page Swamp contained from 3,700 to 26,800 ppm lead. Surficial deposits in the East Page Swamp range from 3,540 to 5,990 ppm lead for 0 to 3 inches in depth. The lead content decreases substantially with increasing depth in the East Page Swamp area, samples from 6 to 18 inches had lead concentrations ranging from 70 to 392 ppm, which is probably a background concentration range for the valley bottom material (McCulley, Frick and Gilman Inc., 1992).

TABLE 1-1

Summary of Soil Analytical Results

Sample Location	Sample Date	Total Lead, Method 3050/7420 (mg/kg)			
		Depth Interval (inches)			
		0-3"	3-6"	6-18"	18-36"
T-1	6-May-93	20,700	20,700	19,000	33,300
T-2	6-May-93	15,200	26,800	637	179
T-3	6-May-93	5,740	24,100	13,800	368
T-4	6-May-93	4,670	9,770	8,660	26,800
T-5	6-May-93	11,500	3,700	5,240	11,900
T-6	6-May-93	5,990	1,390	70	--
T-7	6-May-93	3,960	4,840	392	--
T-8	6-May-93	3,540	182	147	--
T-9	6-May-93	3,780	1,730	240	--
T-10*	6-May-93	11,200	6,490	5,470	12,800

Notes: * T-10 is a duplicate of T-5

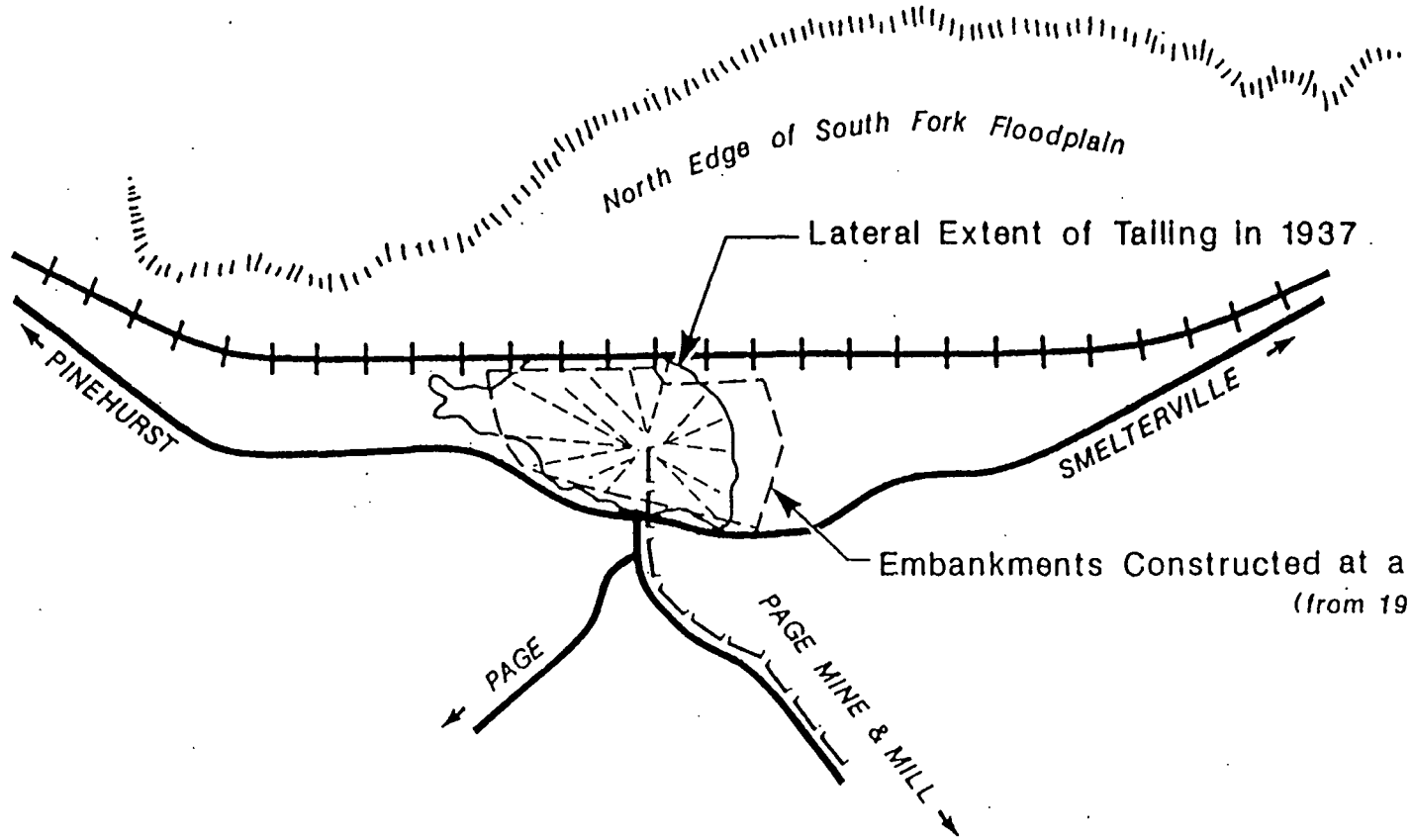
-- Soil not sampled or analyzed at this location

4.0 CONCLUSIONS

The results of the sampling indicate that there are deep deposits of fine grained tailings at both ends of the West Page Swamp. The western deposit is approximately 10 feet thick immediately east of Highway 10 and thins to a thickness of approximately 6 inches at sample point T-2. The east deposit of the West Page Swamp is approximately 7.5- feet thick immediately west of the west embankment of the Page tailing impoundment and thins to less than 18 inches at sample point T-3.

Lead is present in near surface soils throughout the East Page Swamp. Because lead is present only in relatively high concentrations from 0 to 6 inches in depth, and the presence of a relatively consistent developed soil horizon, it is possible that the lead was emplaced as airborne deposition.

Tailings are present in deposits from a minimum of 6.5 to 8 feet deep in the channel between the north Page tailing impoundment and the railroad embankment near the northeast decant of the Page tailing impoundment. Historical records show that tailings were being deposited adjacent to more that 1,000 feet of railroad embankment in 1937 (Figure 1-2), therefore, indicating that relatively deep deposits of tailings may be present throughout the channel area between the northern side of the Page tailing impoundment and the railroad.



Source (Gross, 1982)

REMEDIAL ACTION WORK PLAN
Bunker Hill Superfund Site

LOCATION & EXTENT OF PAGE TAILINGS PILE PRIOR TO EMBANKMENT CONSTRUCTION

PROJECT: 93-2339	DATE: July, 1993	
REV:	BY: FLC	CHECKED:

McCULLEY, FRICK & GILMAN, INC.
Environmental Sciences & Engineering

Figure 1-2

5.0 REFERENCES

Campbell, Stewart - (Inspector of Mines). 1929. Thirty-first Annual Report of the Mining Industry of Idaho for the year 1929. 1929. p. 224.

Engineering and Mining Journal. January 1918. June 1918. Volume 105. p. 716.

Gross, M.R. 1982. Reclamation Plans for Abandoned Mill Tailings Impoundments in the South Fork Coeur d'Alene River Basin. A Masters Degree Thesis from the University of Idaho, Moscow, Idaho. April 1982. pp. 44-48.

McCulley, Frick and Gilman, Inc., 1992. Bunker Hill Superfund Site Remedial Investigation Report. Volume II. May 1, 1992. p. 177.

FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	T-1
Location:	Approximately 300' East of Highway 10			Date:	05/06/93
Geologist:	JS			Method:	Hand Auger

Depth In Inches	Lithology Symbol	Compactness Or Consistency	Description
0-3	SM	Loose	Silty Sand, red, fine to medium grained,
			sub-rounded to sub-angular,
			approximately 5% organics,
			saturated-tailings.
3-6	SM	Loose	As above.
6-18	SM	Loose to Med.	Mix of red and gray silty sand, fine to
		Dense	medium grained, sub-rounded to
			angular, approximately 2%-5%
			organics-tailings.
18-36	ML	Firm	Silt, gray, plastic, no organics, saturated.

COMMENTS:

Sample taken at West End of Page Pond, Approximately 300' East of Highway 10.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	T-2
Location:	Approximately 2000' West of West Decant			Date:	05/06/93
Geologist:	JS			Method:	Hand Auger

Depth In Inches	Lithology Symbol	Compactness Or Consistency	Description
0-3	SM	Loose	Silty Sand, tan and orangish-brown, fine
			to medium grained, approximately 20%
			organics, saturated.
3-6	ML	Firm	Silt, orange, approximately 10% organics,
			saturated.
6-18	ML	Firm	Silt, light brown, <2% organics, wet.
18-36	ML	Firm	As above.

COMMENTS:

Sample location accessed with a boat. At sample point, there was approximately one foot of water.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	T-3
Location:	Approximately 1500' West of West Decant			Date:	05/07/93
Geologist:	JS			Method:	Hand Auger

Depth In Inches	Lithology Symbol	Compactness Or Consistency	Description
0-3	ML/OH	Soft	Silt, black, with approximately 80% grass and other organics.
3-4	OH	Soft	Organic silts, tan and black, saturated.
4-6	SM	Loose	Silty Sand, reddish-brown with approximately 30% organics (grass and roots), saturated.
6-18	SM	Med. Dense	Silty Sand, brown, fine to coarse grained, rounded approximately 30%, some red mottling, 5% organics.
18-36	SM	Med. Dense	Silty Sand, light to medium brown, fine to medium grained, some orangish-red mottling, wet.

COMMENTS:

Approximately 1-2 inches of water on top of the ground surface. Area has grass with low shrubs surrounded by cattails on all 4 sides.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	T-4
Location:	Approximately 950' West of West Decant			Date:	05/07/93
Geologist:	JS			Method:	Hand Auger

Depth In Inches	Lithology Symbol	Compactness Or Consistency	Description
0-2	OH	Soft	Organics - grasses, some new growth and some partially decomposed.
2-3	ML	Loose	Sandy Silt, reddish-orange, fine to medium grained, saturated.
3-6	ML	Loose/Soft	Varied layers of Sandy Silt, reddish-orange with partially decomposed organics, saturated.
6-18	ML	Firm	Sandy Silt, orangish-red with less than 10% gray clay, less than 5% organics.
18-36	SM	Med. Dense	Silty Sand, grayish-black, mottled with tan orange silt, less than 5% organics.

COMMENTS:

Sample location is covered by approximately 1-2 inches of water. Area is covered with wetland grasses.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	T-5
Location:	Approximately 450' West of West Decant			Date:	05/07/93
Geologist:	JS			Method:	Hand Auger

Depth In Inches	Lithology Symbol	Compactness Or Consistency	Description
0-3	OH/ML	Soft	Mixture of approximately 60% black organics
			(leaves, roots, branches) and approximately
			40% tan silt, saturated.
3-6	OH/ML	Soft	As above.
6-18	ML	Firm	Sandy Silt, reddish-orange, approximately
			5% organics, saturated.
18-36	ML	Firm	Silt, mottled orange and gray, wet.

COMMENTS:

Sample location in a small wooded area with aspen and alder trees. Little or no grass.
Approximately 2-3 inches of water on the ground surface.
Note: T-5 is a duplicate of T-10.

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FIELD LOG OF BORING

Job No.:	2339	**Client:**	ASARCO	**Boring:**	T-6
Location:	Approximately 250' West of West Decant			**Date:**	05/07/93
Geologist:	JS			**Method:**	Hand Auger

Depth In Inches	Lithology Symbol	Compactness Or Consistency	Description
0-3	OH	Soft	Dark brown organics, including old cattail growth, saturated.
3-6	OH	Soft	Black organics, partially decomposed, saturated.
6-18	ML	Firm	Silt, gray, mottled with reddish-brown silt, < 5% organics.

COMMENTS:

Sample area at eastern end of cattail marsh. Approximately 1 1/2' of water covering sample area.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	T-7
Location:	Approximately 850' East of East Edge of PPWTP			Date:	05/06/93
Geologist:	JS			Method:	Hand Auger

Depth In Inches	Lithology Symbol	Compactness Or Consistency	Description
0-3	OH	Soft	Medium to dark brown organics with approximately 10% light brown silt, saturated.
3-6	OH	Firm	As above.
6-12	OH	Firm	As above.
12-18	ML	Firm	Silt, light brownish-gray with approximately 5% orange and red mottling.

COMMENTS;

Sample area has approximately 2 inches of water on ground surface. Area covered with grasses.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	T-8
Location:	Approximately 1300' East of East Side of PPWTP			Date:	05/06/93
Geologist:	JS			Method:	Hand Auger

Depth In Inches	Lithology Symbol	Compactness Or Consistency	Description
0-3	OH	Firm	Dark brown organics with approximately 20% light brownish-gray silt.
3-6	ML	Firm	Silt, light grayish-brown with less than 5% organics, approximately 5%-10% redish-brown mottling, groundwater at approximately 4" below ground level.
6-18	ML	Firm	Sandy Silt, light brownish-gray, increased gravel (approximately 20% gravel @ 15"), saturated, mottled sand balls, orangish-red, <1/4" diameter, dry and crumbly with moderate pressure.

COMMENTS;

Sample location covered with low grasses mixed with some moss. Short shrubs in vicinity.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	T-9
Location:	Approximately 1300' East of East Edge of PPWTP			Date:	05/06/93
Geologist:	JS			Method:	Hand Auger

Depth In Inches	Lithology Symbol	Compactness Or Consistency	Description
0-3	OH	Soft	Dark brown organics, saturated.
3-6	OH	Soft	Black organics, decomposed, saturated.
6-12	OH	Soft	As above.
12-18	ML	Firm	Sandy Clayey Silt, light brownish-gray, <2% orangish-brown mottling, <5% organics, saturated.

COMMENTS:

Sample location in grass field with approximately 1-2 inches standing water.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	D-1
Location:	Approximately 15' East of Highway 10 at West Side of P. Pond			Date:	05/13/93
Geologist:	BR			Method:	Hand Auger

Depth In Feet	Lithology Symbol	Compactness Or Consistency	Description
0-4	SM	Loost to	Silty Sand, yellowish-orangish-red, fine to
		Med. Dense	medium grained, moist-tailings.
4-8	ML	Soft	Silts, gray, very soft, wet.
8-8.5	OH	Soft	Organic layer, black.
8.5-10.	ML	Very Stiff	Sandy Silt, black, wet.

COMMENTS:

Refusal at 10 feet.

Ground surface mostly tailings with no vegetation.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	D-2
Location:	Approximately 100' East of Highway 10			Date:	05/06/93
Geologist:	JS			Method:	Hand Auger

Depth In Feet	Lithology Symbol	Compactness Or Consistency	Description
0-15	SM	Med. Dense	Silty Sand, reddish-brown, medium dense, fine to coarse grained, sub-rounded to angular, moist.
1.5-1.8	SM	Very Dense	Cemented sand layer, dry.
1.8-6.3	ML	Very Soft	Sandy Silt, grayish-black, very soft, plastic, varied sand content (2%-30%), wet.
6.3-6.6	OH	Firm	Organics black, partially decomposed bark, branches and other wood debris.
6.6-9.5	ML	Very Stiff	Sandy Silt to Silt, grayish-black, very stiff. plastic, wet.
9.5-10.7	SM	Very Dense	Silty Clayey Sand, grayish-black, fine to medium grained, very dense, wet.
10.7	Gm	Very Dense	Sandy gravel, dark gray, rounded to sub-rounded, wet.

COMMENTS:

No refusal, exceeded penetration capacity of hand auger.

No vegetation on the tailings.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	D-3
Location:	Approximately 150' East of Highway 10			Date:	05/06/93
Geologist:	JS			Method:	Hand Auger

Depth In Fee	Lithology Symbol	Compactness Or Consistency	Description
0-1.8	SM	Med. Dense	Silty Sand, reddish-brown, fine to coarse grained, moist.
1.8-2.0	SM	Very Dense	Cemented Sand, reddish-orange, vsery dense, dry.
2.0-6	ML	Very Soft	Sandy Clayey Silt, gray to grayish-black, very soft to soft, plastic, wet.
6-6.5	SM	Med. Dense	Silty Sand, grayish-black, medium dense, wet.
6.5-6.75	OH	Firm	Organics, black, grass and sticks, lower.
6.76-7.8	ML	Stiff	Sandy Silt, grayish-black with green mottling, stiff, moist.
7.8-8.4	SM	Med. Dense	Sand, grayish-black, fine to medium grained, sulfur odor, wet.
8.4	GM	Dense	Gravel, rounded to sub-rounded, weathered surface, wet.

COMMENTS:

Auger refusal at 8.4 feet.

Surface consists of tailings with no vegetation.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	D-4
Location:	Approximately 200' East of Highway 10			Date:	05/06/93
Geologist:	JS			Method:	Hand Auger

Depth In Feet	Lithology Symbol	Compactness Or Consistency	Description
0-1.5	SM	Med. Dense	Silsty Sand, reddish-brown, fine to medium grained, moist, tailings.
1.5-2	SM	Loose/Soft	Silty Sand, reddish-brown, wet with approximately 50% mottling, grayish-black.
2-6.7	ML	Soft	Clayey Sandy Silt, grayish-black, plastic, wet.
6.7-6.9	OH	Firm	Organics, black (sticks, bark, and twigs).
6.9-7.6	ML	Stiff	Sandy Clayey Silt, black, plastic, sulfur odor, wet.
7.6-7.8	GM	Dense	Silsty Sandy Gravel, black, rounded to sub-rounded, sulfur odor, wet.

COMMENTS:

Auger refusal at 7.8 feet.

Boring site on tailings, next to the waters edge. No vegetation.

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FIELD LOG OF BORING

Job NO.:	2339	Client:	ASARCO	Boring:	D-5
Location:	Approximately 300' West of Page Pond Western Decant			Date:	05/07/93
Geologist:	JS			Method:	Hand Auger

Depth In Feet	Lithology Symbol	Compactness Or Consistency	Description
0-3	SM	Med. Dense	Silty Sand, reddish-brown, fine to medium grained, medium dense, moist.
3-6	ML	Soft	Sandy Silt, grayish-black, plastic, soft, wet.
6-6.2	OH	Firm	Organics, (twigs and sticks), black, wet.
6.2-7.2	ML	Firm	Sandy Silt, grayish-black, plastic, firm, wet.
7.2-7.5	GM	Dense	Sandy Gravel, black, rounded to sub-rounded, dense, wet.

COMMENTS:

Auger refusal at 7.5 feet.

Some vegetative cover on the tailings.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	D-6
Location:	Approximately 200' West of Page Pond Western Decant			Date:	05/07/93
Geologist:	JS			Method:	Hand Auger

Depth In Feet	Lithology Symbol	Compactness Or Consistency	Description
0-2.8	SM	Med. Dense	Silty Sand, reddish-brown, fine to medium grained, medium dense, moist.
2.8-7.2	ML	Soft	Sandy Silt, grayish-black, plastic, soft, wet, localized sand beds, wet.
7.2-7.5	GM	Dense	Sandy Gravel, black, rounded to sub-rounded, dense, wet.

COMMENTS:

Auger refusal at 7.5 feet.

Sparse vegetative cover over tailings.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	D-7
Location:	Approximately 10' West of Page Pond Western Decant			Date:	05/07/93
Geologist:	JS			Method:	Hand Auger

Depth In Feet	Lithology Symbol	Compactness Or Consistency	Description
0-2.8	SM	Med. Dense	Silty Sand, reddish, yellowish, brown, fine to medium grained, medium dense, moist.
2.8-6	ML	Loose	Sandy Silt, grayish-black, plastic, soft, wet.
6.-6.3	OH	Firm	Organics, (bark and twigs), black, wet.
6.3-7.2	ML	Firm	Sandy, Clayey Silt, grayish black, firm, wet.
7.2-7.5	GM	Dense	Sandy Gravel, black, rounded to sub-rounded, dense, wet.

COMMENTS:

Auger refusal at 7.5 feet.

Little or no vegetative cover on tailings.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	D-8
Location:	Approximately 21' North of NE Decant, Page Pond			Date:	05/13/93
Geologist:	JS			Method:	Hand Auger

Depth In Feet	Lithology Symbol	Compactness Or Consistency	Description
0-4	SM	Loose to	Silsty Sand, reddish-brown and
		Med. Dense	grayish-black, loose to medium dense,
			<5% organics, saturated.
4-4.5	OH	Firm	Organics, with <20% sand.
4.5-7.3	SM	Loose to	Silty Sand, grayish-black, loose to
		Med. Dense	medium dense, wet.
8			Bottom of boring. No recovery.

COMMENTS:

No recovery below 8 feet due to soil conditions.

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FIELD LOG OF BORING

Job No.:	2339	Client:	ASARCO	Boring:	D-9
Location:	Approximately 100' North of NE Decant, Page Pond			Date:	05/13/93
Geologist:	WCR			Method:	Hand Auger

Depth In Feet	Lithology Symbol	Compactness Or Consistency	Description
0-.8	Sm	Med. Dense	Silty Sand, reddish-brown, medium dense,
			<20% organics, saturated.
.8-2.5	ML	Soft	Sandy Sislt, reddish-brown and gray, soft,
			wet.
2.5-6.5	GM	Med. Dense	Gravel, grayish-black, med, dense, wet,
6.5			Refusal at 6.5'.

COMMENTS:

Ground surface has approximately 4 inches of standing water.

Refusal at 6.5 feet.

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SVL ANALYTICAL, INC.

REPORT OF ANALYTICAL RESULTS

CLIENT :McCulley, Frick & Gilman, Inc. SVL JOB No. :30420
Sample Receipt : 5/07/93 Date of Report : 5/20/93

SVL ID	CLIENT SAMPLE ID	Test Method Units	Pb 7420 mg/kg
S39602	T-1 0-3" 5/6/93		20700
S39603	T-1 3-6" 5/6/93		20700
S39604	T-1 6-18" 5/6/93		19000
S39605	T-1 18-36" 5/6/93		33300
S39606	T-2 0-3" 5/6/93		15200
S39607	T-2 3-6" 5/6/93		26800
S39608	T-2 6-18" 5/6/93		637
S39609	T-2 18-36" 5/6/93		179
S39610	T-3 0-3" 5/7/93		5740
S39611	T-3 3-6" 5/7/93		24100
S39612	T-3 6-18" 5/7/93		13800
S39613	T-3 18-36" 5/7/93		368
S39614	T-4 0-3" 5/7/93		4670
S39615	T-4 3-6" 5/7/93		9770
S39616	T-4 6-18" 5/7/93		8660
S39617	T-4 18-36" 5/7/93		26800
S39618	T-5 0-3" 5/7/93		11500
S39619	T-5 3-6" 5/7/93		3700
S39620	T-5 6-18" 5/7/93		5240
S39621	T-5 18-36" 5/7/93		11900

*ppm: units are mg/L for waters and extracts, mg/kg for soils

Reviewed By: K. Gray Date: 05/20/93

VL ANALYTICAL, INC. Quality Control Report

Client :McCulley, Frick & Gilman, Inc. SVL JOB No. :30420

Test	Method	Matrix	Blank	LCS	LCS %R	Dup RPD	Spk Add	Spk %R
	7420	SO	<10.0 mg/kg	49.0 mg/kg	98.00	2.44	---	

QC Sample: SVL SAM No. :39602, Client Sample ID :T-1 0-3" 5/6/93

LEGEND:

Blank = Preparation Blank, LCS = Laboratory Control Sample, LCS %R = LCS Percent Recovery, Spk Add = Spike Added, N/A = Not Applicable
Dup RPD = Duplicate Relative Percent Difference (i.e., |Sam - Dup|/((Sam + Dup)/2) * 100), Spk %R = Spike Percent Recovery

	SPK ADD	SPK %R
POST DIGEST SPIKE -	10,000 mg/kg	91.1

SVL ANALYTICAL, INC.

REPORT OF ANALYTICAL RESULTS

CLIENT :McCulley, Frick & Gilman, Inc. | SVL JOB No. :30421
Sample Receipt : 5/07/93 | Date of Report : 5/20/93

SVL ID	CLIENT SAMPLE ID	Test Method Units	Pb 7420
S39624	T-6 0-3" 5/6/93	mg/kg	5990
S39625	T-6 3-6" 5/6/93	mg/kg	1390
S39626	T-6 6-18" 5/6/93	mg/kg	70
S39627	T-7 0-3" 5/6/93	mg/kg	3960
S39628	T-7 3-6" 5/6/93	mg/kg	4840
S39629	T-7 6-18" 5/6/93	mg/kg	392
S39630	T-8 0-3" 5/6/93	mg/kg	3540
S39631	T-8 3-6" 5/6/93	mg/kg	182
S39632	T-8 6-18" 5/6/93	mg/kg	147
S39633	T-9 0-3" 5/6/93	mg/kg	3780
S39634	T-9 3-6" 5/6/93	mg/kg	1730
S39635	T-9 6-18" 5/6/93	mg/kg	240
S39636	T-10 0-3" 5/7/93	mg/kg	11200
S39637	T-10 3-6" 5/7/93	mg/kg	6490
S39638	T-10 6-18" 5/7/93	mg/kg	5470
S39639	T-10 18-36" 5/7/93	mg/kg	12800
W39902	ERB 5/17/93	mg/l	<0.1
W39903	D.I. BLANK 5/17/93	mg/l	<0.1

*ppm: units are mg/L for waters and extracts, mg/kg for soils

Reviewed By: K. Gray Date: 05/20/93

SVL ANALYTICAL, INC. Quality Control Report

Client :McCulley, Frick & Gilman, Inc. SVL JOB No. :30421

Test	Method	Matrix	Blank	LCS	LCS %R	Dup RPD	Spk Add	Spk %R
[redacted]	7420	SO	<10.0 mg/kg	51.0 mg/kg	102.00	2.15		

QC Sample: SVL SAM No. :39624, Client Sample ID :T-6 0-3" 5/6/93

LEGEND:

Blank = Preparation Blank, LCS = Laboratory Control Sample, LCS %R = LCS Percent Recovery, Spk Add = Spike Added, N/A = Not Applicable
Dup RPD = Duplicate Relative Percent Difference (i.e., |Sam - Dup|/((Sam + Dup)/2) * 100), Spk %R = Spike Percent Recovery

	SPK ADD	SPK %R
POST DIGEST SPIKE -	5000.0 mg/kg	104.2

CHAIN-OF-CUSTODY RECORD AND REQUEST FOR ANALYSIS

McCULLEY, FRICK & GILMAN, INC.

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FAX: (208) 556-7271

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FAX: (512) 454-4126

☐ 5 Third St., Suite 400
San Francisco, CA 94103
TEL: (415) 495-7110
FAX: (415) 495-7107

PROJECT No.: _____ PROJECT NAME: PAGE WETLAND PAGE: 1 OF: 4

SAMPLER (Signature): [signature] PROJECT MANAGER: BILL RUST DATE: 5/7/93

METHOD OF SHIPMENT: _____ CARRIER/ WAYBILL NO. _____ DESTINATION: SVL

SPECIAL INSTRUCTIONS/HAZARDS: _____

SAMPLES															ANALYSIS REQUEST																
					Preservation						Containers*			Methods												Handling			REMARKS
Lab No.	Sample Identification	Sample Collection DATE	TIME	Matrix*	HCL	HNO_3	H_2SO_4	COLD	NONE	OTHER	VOL. (ml)	TYPE*	No.	EPA 601/8010	EPA 602/8020	EPA 624/8240	EPA 625/8270	TPH as Gasoline	TPH as Diesel	BTEX	LEAD					HOLD	RUSH	STANDARD	(Special handling procedures, specific analytical methods, observations, etc.)
	T-1, 0-3	5/6		SOIL																									
	T-1, 3-6	↓		↓																									REFER TO ATTACHMENT FOR TEST METHOD
	T-1, 6-13																												
	T-1, 13-36																												
	T-2, 0-3																												
	T-2, 3-6																												
	T-2, 6-12																												
	T-2, 12-36	↓																											
	T-3, 0-3	5/7																											
	T-3, 3-6	↓		↓																									
					TOTAL NUMBER OF CONTAINERS									LABORATORY COMMENTS/ CONDITION OF SAMPLES																

RELINQUISHED BY:			DATE	TIME	RECEIVED BY:		
SIGNATURE	PRINTED NAME	COMPANY			SIGNATURE	PRINTED NAME	COMPANY
[signature]	JEFF SHARP	MFG	5/7/93	11:15	[signature]	GORDON SMITH	SVL ANALYTICAL
							LABORATORY

*KEY: Matrix AO-aqueous NA-nonaqueous SO-soil SL-sludge P-petroleum A-air OT-other Containers P-plastic G-glass T-teflon B-brass OT-other

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PROJECT No.:_____ PROJECT NAME: PAGE WETLAND PAGE: 2 OF: 4

SAMPLER (Signature): [signature] PROJECT MANAGER: BILL RUST DATE: 5/7/93

METHOD OF SHIPMENT:_____ CARRIER/ WAYBILL NO._____ DESTINATION: SVL

SPECIAL INSTRUCTIONS/HAZARDS:

SAMPLES

ANALYSIS REQUEST

Lab No.	Sample Identification	Sample Collection DATE	Sample Collection TIME	Matrix*	Preservation HCL	Preservation HNO_3	Preservation H_2SO_4	Preservation COLD	Preservation NONE	Preservation OTHER	Containers* VOL. (ml)	Containers* TYPE*	Containers* No.	Methods EPA 601/8010	Methods EPA 602/8020	Methods EPA 624/8240	Methods EPA 625/8270	Methods TPH as Gasoline	Methods TPH as Diesel	Methods BTEX	Methods LEAD	Handling HOLD	Handling RUSH	Handling STANDARD	REMARKS (Special handling procedures, specific analytical methods, observations, etc.)
	T-3, 6-18	5/7		SOIL																					REFER TO ATTACHMENT FOR TEST METHOD
	T-3 18-36	↓		↓																					
	T-4 0-3																								
	T-4 3-6																								
	T-4 6-18																								
	T-4 18-36																								
	T-5 0-3																								
	T-5 3-6																								
	T-5 6-18																								
	T-5 18-36	↓		↓																					

TOTAL NUMBER OF CONTAINERS: 1

LABORATORY COMMENTS/ CONDITION OF SAMPLES

RELINQUISHED BY: SIGNATURE	PRINTED NAME	COMPANY	DATE	TIME	RECEIVED BY: SIGNATURE	PRINTED NAME	COMPANY
[signature]	JEFF SHARP	MFG	5/7/93	11:15	[signature]	GORDON ANTHIC	SVL ANALYTICAL
							LABORATORY

*KEY: Matrix AO-aqueous NA-nonaqueous SO-soil SL-sludge P-petroleum A-air OT-other Containers P-plastic G-glass T-teflon B-brass OT-other

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PROJECT No.: _____ PROJECT NAME: PAGE - WETLAND PAGE: 3 OF: 4

SAMPLER (Signature): [signature] PROJECT MANAGER: BILL PAST DATE: 5/7/93

METHOD OF SHIPMENT: _____ CARRIER/ WAYBILL NO. _____ DESTINATION: SVL

SPECIAL INSTRUCTIONS/HAZARDS:

SAMPLES

Lab No.	Sample Identification	Sample Collection DATE	Sample Collection TIME	Matrix*	Preservation HCL	Preservation HNO_3	Preservation H_2SO_4	Preservation COLD	Preservation NONE	Preservation OTHER	Containers* VOL. (ml)	Containers* TYPE*	Containers* No.
	T-6, 0-3	5/6		SOIL									
	T-6, 3-6	↓		↓									
	T-6, 6-18												
	T-7, 0-3												
	T-7, 3-6												
	T-7, 6-9												
	T-8 0-3												
	T-8, 3-6												
	T-8, 6-18	↓		↓									

TOTAL NUMBER OF CONTAINERS

ANALYSIS REQUEST

Methods EPA 601/8010	EPA 602/8020	EPA 624/8240	EPA 625/8270	TPH as Gasoline	TPH as Diesel	BTEX	LEAD	Handling HOLD	RUSH	STANDARD	REMARKS (Special handling procedures, specific analytical methods, observations, etc.)
											REFER TO ATTACHMENT FOR TEST METHOD

LABORATORY COMMENTS/ CONDITION OF SAMPLES

RELINQUISHED BY: SIGNATURE	PRINTED NAME	COMPANY	DATE	TIME	RECEIVED BY: SIGNATURE	PRINTED NAME	COMPANY
[signature]	JEFF SHAFER	MFG	5/7/93	11:15	[signature]	GORDON ANTHIS	SVL ANALYTICAL
							LABORATORY

*KEY: Matrix AO-aqueous NA-nonaqueous SO-soil SL-sludge P-petroleum A-air OT-other Containers P-plastic G-glass T-teflon B-brass OT-other

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PROJECT No.:_____ PROJECT NAME: PELE WETLAND PAGE: 4 OF: 4

SAMPLER (Signature): JSR PROJECT MANAGER: BILL RUST DATE: 5/7/93

METHOD OF SHIPMENT:_____ CARRIER/ WAYBILL NO._____ DESTINATION: SVL

SPECIAL INSTRUCTIONS/HAZARDS:

SAMPLES

ANALYSIS REQUEST

Lab No.	Sample Identification	Sample Collection DATE	Sample Collection TIME	Matrix*	Preservation HCL	Preservation HNO_3	Preservation H_2SO_4	Preservation COLD	Preservation NONE	Preservation OTHER	Containers* VOL. (ml)	Containers* TYPE*	Containers* No.	Methods EPA 601/8010	Methods EPA 602/8020	Methods EPA 624/8240	Methods EPA 625/8270	Methods TPH as Gasoline	Methods TPH as Diesel	Methods BTEX	Methods LEAD	Handling HOLD.	Handling RUSH	Handling STANDARD	REMARKS (Special handling procedures, specific analytical methods, observations, etc.)
	T-9, 0-3	5/6		SOIL																					REFER TO ATTACHMENT FOR TEST METHOD
	T-9, 3-6	↓		↓																					
	T-9, 6-18	↓		↓																					
	T-10, 0-3	5/7		↓																					
	T-10, 3-6	↓		↓																					
	T-10, 6-18	↓		↓																					
DUPLICATE OF T-5	T-10, 18-36	↓		↓																					

TOTAL NUMBER OF CONTAINERS

LABORATORY COMMENTS/ CONDITION OF SAMPLES

RELINQUISHED BY: SIGNATURE	PRINTED NAME	COMPANY	DATE	TIME	RECEIVED BY: SIGNATURE	PRINTED NAME	COMPANY
JSR	JEFF SHARP	MFG	5/7/93	11:15	[illegible]	GORDON ANTHIS	SVL ANALYTICAL
							LABORATORY

*KEY: Matrix AO-aqueous NA-nonaqueous SO-soil SL-sludge P-petroleum A-air OT-other Containers P-plastic G-glass T-teflon B-brass OT-other

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PROJECT No.:_____ PROJECT NAME: PAGE WETLAND PAGE:____ OF:____

SAMPLER (Signature): [signature] PROJECT MANAGER: BILL RUST DATE: 5/17/93

METHOD OF SHIPMENT:_____ CARRIER/ WAYBILL NO._____ DESTINATION: SVL

SPECIAL INSTRUCTIONS/HAZARDS:

SAMPLES

ANALYSIS REQUEST

Lab No.	Sample Identification	Sample Collection DATE	Sample Collection TIME	Matrix*	Preservation HCL	Preservation HNO_3	Preservation H_2SO_4	Preservation COLD	Preservation NONE	Preservation OTHER	Containers* VOL. (ml)	Containers* TYPE*	Containers* No.	Methods EPA 601/8010	Methods EPA 602/8020	Methods EPA 624/8240	Methods EPA 625/8270	Methods TPH as Gasoline	Methods TPH as Diesel	Methods BTEX	Methods LEAD (Pb)	Handling HOLD	Handling RUSH	Handling STANDARD	REMARKS (Special handling procedures, specific analytical methods, observations, etc.)
	ERB	5/17/93	10:30	H_2O		X					1 liter		1								X				
	D.I. BLANK	5/17/93	11 AM	H_2O		X					"		1								X				REFER TO ATTACHMENT FOR TEST METHOD.
																									ATTACH TO SVL 30421

TOTAL NUMBER OF CONTAINERS

LABORATORY COMMENTS/ CONDITION OF SAMPLES

RELINQUISHED BY: SIGNATURE	PRINTED NAME	COMPANY	DATE	TIME	RECEIVED BY: SIGNATURE	PRINTED NAME	COMPANY
[signature]	JEFFREY SHELP	MFG	5/17/93	11:25	Eric Harwood	Eric Harwood	SVL Analytical
							LABORATORY

*KEY: Matrix AO-aqueous NA-nonaqueous SO-soil SL-sludge P-petroleum A-air OT-other Containers P-plastic G-glass T-teflon B-brass OT-other

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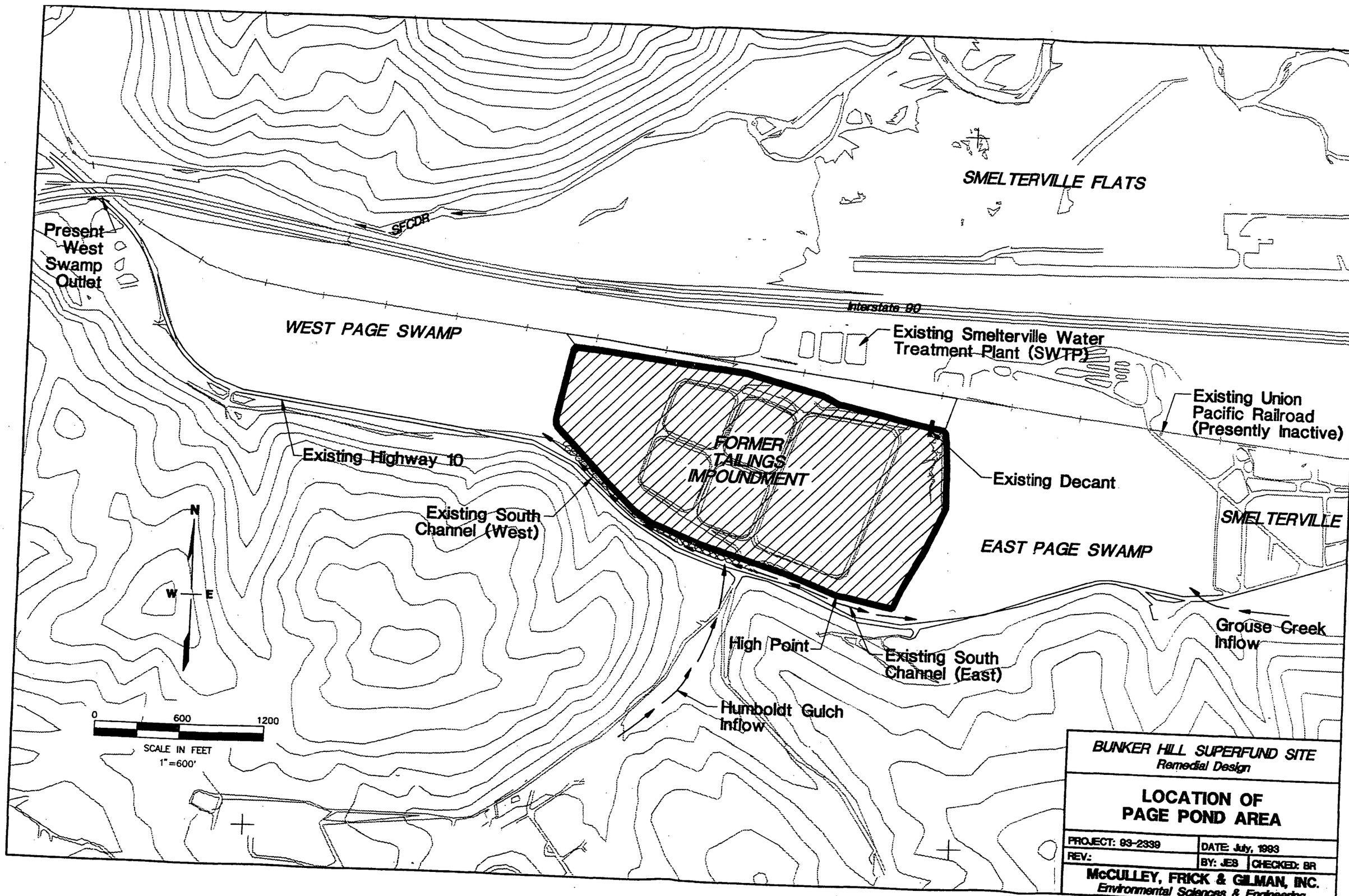


BUNKER HILL SUPERFUND SITE
Remedial Design

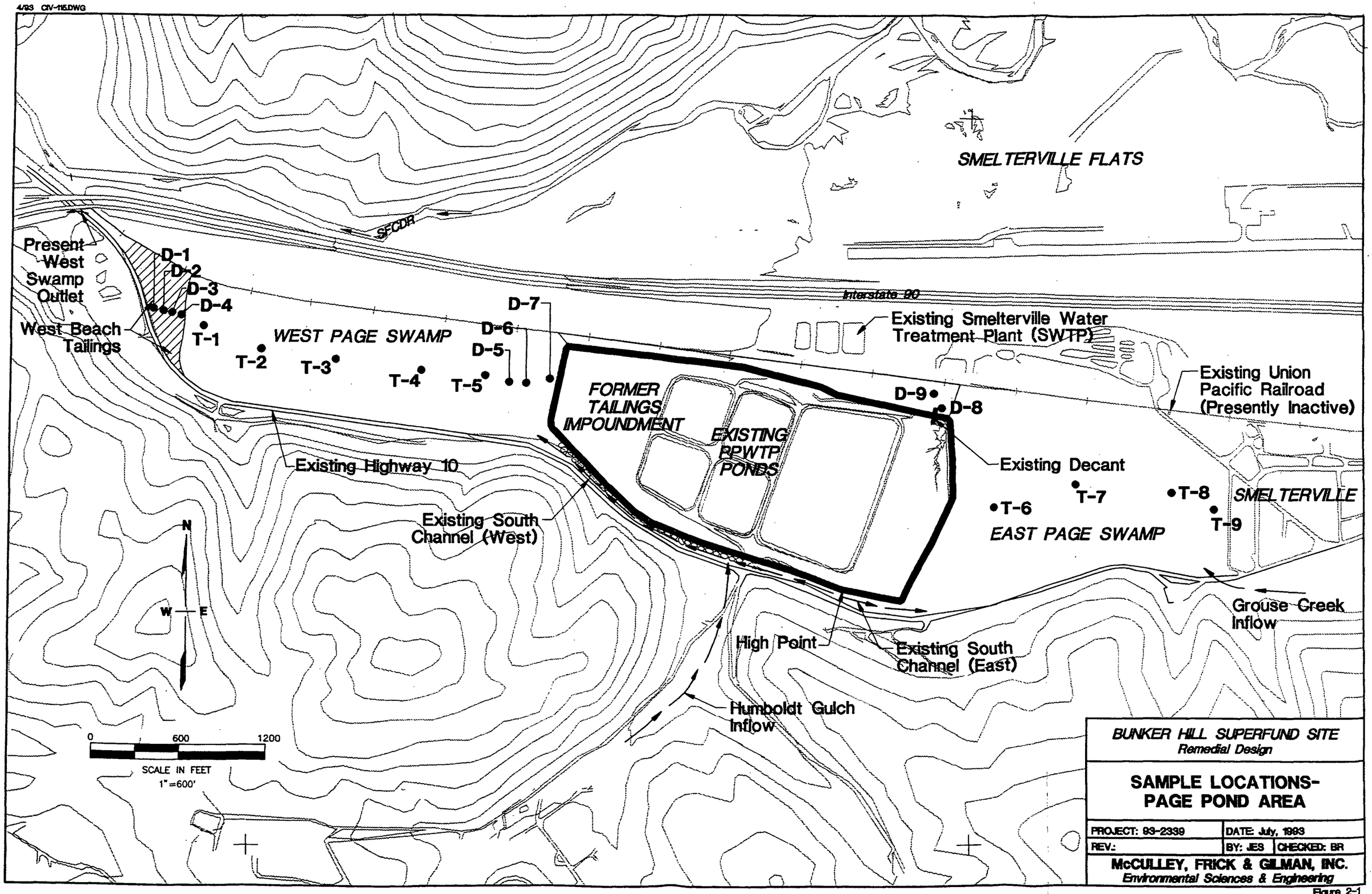
LOCATION OF PAGE POND AREA

PROJECT: 93-2339	DATE: July, 1993	
REV.:	BY: JES	CHECKED: BR

McCULLEY, FRICK & GILMAN, INC.
Environmental Sciences & Engineering

Figure 1-1

4/93 CIV-115.DWG



BUNKER HILL SUPERFUND SITE
Remedial Design

**SAMPLE LOCATIONS-
PAGE POND AREA**

PROJECT: 93-2339	DATE: July, 1993	
REV.:	BY: JES	CHECKED: BR

McCULLEY, FRICK & GILMAN, INC.
Environmental Sciences & Engineering

Figure 2-1

APPENDIX B

APPENDIX B

Appendix B

Supporting Calculations for Estimated Availability and Utilization of Disposal Capacity at Page Pond Benches

General Notes

- Calculations based on dimensions taken from aerial photo topographic mapping prepared in 1987
  - Horizontal scale: 1 inch = 100 feet
  - Contour interval: 2 feet
- Volumes calculated by method of average end areas
- For convenience, some dimensions have been averaged and resulting volumes are approximate
- It is assumed that the fill materials will be placed such that the maximum elevation of the upper surface is 0.5 feet below the elevation of the existing PPWTP dike crest and that the fill surface will be graded away from the dike at 0.5 percent minimum.
- It is assumed that the perimeter slopes of the fills will be graded at 3 horizontal to 1 vertical.

Original East Bench Capacity

• Avg. N-S dimension	1,300 ft
• Avg. E-W dimension	375 ft
• Westerly fill depth (at PPWTP dike)	6 ft
• Easterly fill depth	4 ft
• Westerly fill x-sect. area $\frac{(1,300 + 1,264)}{2} \times 6$	7,700 sf
• Easterly fill x-sect. area $\frac{(1,300 + 1,276)}{2} \times 4$	5,150 sf
• Available disposal volume $\frac{(7,700 + 5,150)}{2} \times 375$	2,409,375 cf
	89,236 cy
	Allow 90,000 cy

Original West Bench Capacity

• N-S dimension at east side	920 ft
• N-S dimension at west side	590 ft
• Avg. E-W dimension	630 ft
• Easterly fill depth	14.5 ft
• Westerly fill depth	11.5 ft

- Easterly fill x-sect. area
  $\frac{(920 + 830)}{2} \times 14.5$ — 12,690 sf
- Westerly fill x-sect. area
  $\frac{(590 + 520)}{2} \times 11.5$ — 6,380 sf
- Available disposal volume
  $\frac{(12,690 + 6,380)}{2} \times 630$ — 6,007,050 cf

222,480 cy

Allow 220,000 cy

West Bench Expansion Capacity

- N-S dimension at east side — 620 ft
- N-S dimension at west side — 450 ft
- Avg. E-W dimension — 200 ft
- Easterly fill depth — 31.5 ft
- Westerly fill depth — 31.5 ft
- Easterly fill x-sect. area
  $\frac{(620 + 430)}{2} \times 31.5$ — 16,537 sf
- Westerly fill x-sect. area
  $\frac{(450 + 260)}{2} \times 31.5$ — 11,180 sf
- Available disposal volume
  $\frac{(16,537 + 11,180)}{2} \times 200$ — 2,771,700 cf

102,655 cy

Allow 100,000 cy

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